POWER

Established 1884—McGraw-Hill Publishing Company, Inc.

ELY C. HUTCHINSON, *Editor*

VOLUME 74 NOVEMBER 3, 1931 NUMBER 18

Engineer's Competition

Every man has experienced that welling within, which made him rush to the defense of the smaller person who fought fairly against the odds of a bulkier physique. The battle cry usual to these occasions is "Why don't you take a fellow your own size!"

Now it became known that a certain progressive industry had decided to modernize its power plant. The job was in the class ordinarily beneath the notice of the large engineering-contracting firms and typical of the sort suited to high class consulting engineers.

Despite this, the contracting companies have besieged the owner with requests to do all the engineering, for nothing but the privilege of quoting on the machinery and installation. Some have already done this. Others are eagerly awaiting their turn.

Meantime the consulting engineer helplessly sees his stock in trade and only means of livelihood swept away by a situation which, even in less difficult times, would have little to defend it.

Because contracting companies have their problems these days is no reason for forgetting that consulting engineers also have theirs—and the contracting companies should not add to them.

Ethical standards are still worth something.

EDITORIALS

Local Cooperation On Employment

Because of the widespread unemployment among engineers, numerous committees have been formed among the various engineering societies to help ease the situation. Their objectives range all the way from assisting their own members to economic surveys and studies of technological unemployment. As was pointed out in a previous editorial, there is obviously much duplication of effort which needs coordination, and the broader studies should be left to the American Engineering Council.

Locally, however, there is much that can be done by the engineering societies through cooperation with local employment bodies. The latter are set up to deal with emergency relief and general employment, without reference to specialized work, yet their contacts undoubtedly bring them in touch with openings where engineers could be placed. The engineering society committees could render assistance in such cases and the benefits would be mutual.

Steam Driven Auxiliaries

Fifteen or twenty years ago it was customary to employ steam-driven auxiliaries in central stations. These included small steam engines or turbines of comparatively low first cost, as the driving elements. Their steam consumption was high, oil requirement great and attendance and maintenance costs often excessive.

The increased reliability of electric motors and their control and the higher over-all plant efficiency obtainable led to the present extended use of electric drive for nearly all station auxiliaries. In fact some modern power stations have only one steam-driven auxiliary, the reserve boiler-feed pump.

Power requirements of certain auxiliaries in our largest plants are now great, and the control of these large motors, particularly when of the alternating-current type, adds complication and increases plant cost. If boiler and turbine units increase still further in size, and there is every indication that they will, auxiliaries of still larger capacity will be needed.

On the other hand, attention has been directed of late to the improvement in the efficiencies of smaller turbines, and one finds in commercial operation in industry highly efficient turbine-driven pumps, fans and other similar units of sizes now adaptable to the larger auxiliaries.

Dr. F. Munzinger, the well-known German engineer, has recently proposed to employ turbine units for auxiliary drives in new European plants with boilers and turbines designed for high ratings at peak loads. He points out that such large auxiliaries can be driven by highly efficient steam turbines, the exhaust from which would be employed to heat feed water instead of using bled steam from the main turbines. This would increase the output of the main units.

The steam turbine drive should usually be cheaper than the complicated motor drive; would make any gradation of speed possible, and should at least equal in economy the motor-driven station.

Dr. Munzinger claims that such a plant would cost 3 per cent less for pressures of four hundred pounds and 4.5 per cent for twelve hundred pounds.

Similar studies are being made in this country. The turbine-driven forced- and induced-draft fans at Hell Gate station embody this idea, and their performance is being watched with interest by engineers.

The reasoning is sound, and the proposal to use the steam drive for large units warrants careful consideration and analysis in all new stations.

Erratic Life of Elevator Ropes

Experience has shown that life of elevator ropes may be a very uncertain quantity. The hoist rope on some traction-type machines has given over seventy thousand miles of service, where on other installations it has been around five thousand. Many factors may be set forth to account for this extremely wide difference in rope life, but how much, if any, each contributes is more or less conjectural.

Recent studies indicate that the possibilities of unequally loading the ropes are far greater than generally appreciated. Tests on what would be considered normal operating elevators have shown that the difference in loading of traction-machine hoist ropes may vary as much as three to one. These findings have been further substantiated by the unequal stretch of rope where automatic equalizers are used. A few weeks after ropes were installed on some machines, unequal stretch caused a difference of several inches in their lengths.

Heavily loaded rope should be expected to fail prematurely. Tests show that a lightly loaded rope may also deteriorate rapidly. The latter is more serious than the former, because the majority of broken

wires in a lightly loaded rope occur next to the core, where they cannot be seen. The broken wires in a heavily loaded rope generally appear on the outside, where they are visible.

Some rather unexpected rope failures have occurred on traction elevators and cannot be readily explained. If one rope in a group were to fail, it would apparently be the one with the heaviest load. The tests referred to show that a lightly loaded rope may fail also. It may be that this is the answer as to why a rope that appeared to be in good condition on the outside broke shortly after it had been inspected. More data are needed before definite conclusion can be made, but those so far obtained are strongly suggestive that unequal loading is a major factor in causing short rope life.

Hotel Accountants And Power Costs

Like the doctor who cured fits only, men generally pay attention to those things they understand, and neglect the rest as far as possible. None of us is immune to this myopia. Some engineers cannot see the men for the machinery. To the lawyer life consists largely of legal precepts. Salesmanship is the whole story of civilization—to the salesman.

In common with other men, the hotel accountant—be he consultant or employee—has this habit of not seeing what he should outside the circle of his pet interests. One of these is food. Understanding of food costs is in the A, B, C, of hotel accounting. In the better-managed institutions every meal has its cost known as well as its price. The meals of the men that make the meals and serve them are figured, and every other mouth in the establishment has its corresponding food record.

This is all very well, and of great value in reducing costs. The only trouble is that the food-cost hobbyist is generally blind as a bat when it comes to power. If one suggested that he pool all food costs as a single item of hotel operation he would hold up his hands in holy horror. He would see at once that control would disappear and waste go on a rampage. Yet with the utmost complacency he includes in the single item, "heat, light and power," the power services whose consumption is equally controllable, and whose waste is equally certain without such control.

One reason for this peculiar situation is mere oversight arising from specialized interest. Another is that very few hotel accountants, even consulting accountants, know how to break down the total cost of "power, heat and light" into costs of the individual services. For example, how many accountants could intelligently divide the cost of steam entering an engine into the power produced and the exhaust steam?

To handle such problems, hotel engineers must put power engineers on their staffs, or else work closely with the power engineers in hotels. A little cooperation will insure a correct distribution of costs among the various power services. And then, if the hotels will take a leaf from the books of successful industrial plants, they will save a lot of money by individually metering the power services delivered to kitchens, laundries, public rooms, dining rooms and guest rooms.

Watch the Local Fuel Market

Similarity in the combustion characteristics of pulverized coal, fuel oil and natural gas has made it possible to burn any or all of them in the same boiler furnace with relatively equal efficiencies.

Combination coal, oil and gas burners, efficiently mixing and firing any one or all of these fuels, have been available for some time. Plants now burning any one of the three need only a relatively small added investment to allow the changeover to one of the other two, provided the furnaces are well designed. The economies possible through such flexibility of fuel choice may well justify this.

Today these fuels are becoming economically available to an increasing number of plants. The construction of widespread pipe line networks is extending the use of gas far beyond the geographic limits thought possible a few years ago. Likewise, the marketing of increased quantities of fuel oil, resulting in drastic reductions in delivered price, has placed oil in the position of offering definite fuel economies in consumer markets where coal has hitherto reigned supreme.

Bituminous coal, of course, is always with us. The coal industry has long been in difficulties; but coal will remain, actively fighting for its position as the principal energy source. The effects of the depression, augmented by competition from the other basic fuels, has aggravated these perennial difficulties to the point where some of the country's best organizational minds are applying concerted thought to the industry's problems.

Thus by increased and more economical production and distribution the three basic fuels, coal, oil and gas, are progressively brought into wider and more active competition. Whatever the final outcome, the results should be beneficial as far as steam producers are concerned.

In the meantime the plant so equipped as to utilize economically all three basic fuels is in a postion to take ready advantage of even temporary reductions in the local market price of any one of them.

▼

POWER Stands for . .

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason

The heating, ventilating and elevator services of the new McGraw-Hill Building are described in the following two articles

Zoned Orifice System Heats McGraw-Hill Building

Manual central control of five zones, and elimination of radiator return traps are features of the heating system in this 33-story structure

THE McGraw-Hill Building, which now houses on the thirtieth floor the new home of *Power*, embodies in its construction many unique features. Throughout its design strict attention has been given to the service requirements of a large publishing plant, and to simplicity of architecture. The functional planning to meet the dissimilar needs of editorial, business and printing units has resulted in a structure of unusual economy and efficiency.

The building fronts 130 ft. on Forty-second Street about midway between Eighth and Ninth Avenues, and extends through to Forty-first Street. It is 33 stories high, has a gross first floor area of about 27,000 sq.ft. and a volume of 8,057,000 cu.ft. Setbacks occur on the Forty-first Street side at the sixth and fifteenth floors, and on the Forty-second Street side at the tenth and fifteenth floors. The lower floors of the building have been designed for manufacturing, and will house the mechanical departments of the publishing plant and other tenants. The upper floors have been finished for business and editorial purposes.

The functional planning of the building influenced the heating system design, both as to the square feet of heating surface installed and also as to the type and method of control. Maximum natural lighting was desired on all floors, and as a result the windows form a practically continuous band of glass. The usual masonry mullions between windows were eliminated and replaced by steel mullions. This window treatment is carried out on all four sides of the building, there being in all 3,150 double-hung windows with a glass area of 85,038 sq.ft. This unusual amount of glass surface greatly increases the heat loss from the building, and required the installation of 80,995 sq.ft. of direct radiation, or nearly 1 sq.ft. of radiation for every 100 cu.ft. of volume, an increase in heating requirements of 15 to 20 per cent over that required with the more usual constructions.

In the interest of economy of operation, and of low first cost, a centrally controlled orifice heating system was installed, an unusual feature of which is the absence of radiator traps on all radiators served by the orifice system. Realizing that the editorial offices would probably require a somewhat higher room temperature than the manufacturing floors, and to further economize in the use of steam, the heating system has been zoned so that the various parts of the building may be served with their individual heat requirements. This has resulted in four zones for the tower floors, one zone for the manufacturing floors, and an entirely separate heating system for the sixth floor, where the printing presses are located.

Steam for heating and other uses is furnished by the New York Steam Corporation, and enters the building through an 8-in. main at a pressure of about 125 lb. The 8-in. line runs from the street to a steam room on the east side of the building about midway between Forty-first and Forty-second Streets. Here the main branches to two 6-in. meters that measure the steam during the heating season, and one 2-in. meter for the steam used during both summer and winter. After the meters, the steam pressure is reduced from 125 lb. to 50 lb. pressure by one 8-in. reducing valve, which delivers the 50-lb. pressure steam to an 8-in. sub header. From this header three 8-in. lines deliver steam to the various sections of the heating systems. One of these lines supplies steam through a control valve to an upfeed orifice

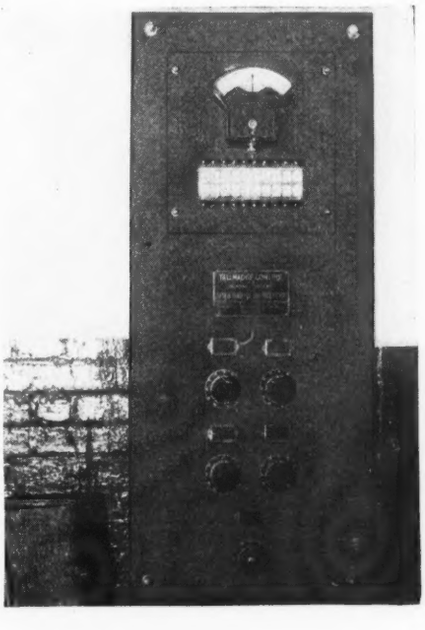


Fig. 1—From this control board the heat to all floors except the sixth can be controlled

system which serves the basement and the first to the seventh floor, inclusive, but excepting the sixth floor, on which the printing presses are located. The second line delivers steam at 50 lb. pressure to a second header located in a pump room on the fifteenth floor, almost directly above the steam meter room. This header serves the four zones of the tower heating system. The third branch from the basement header delivers steam through a reducing valve to the lobby and stores, the sixth floor heating system, and indirect heating of the conference room on the 33rd floor.

The tower heating system, is arranged so that one zone supplies the radiators along the north and west walls from the sixteenth to the thirty-third floors. Another

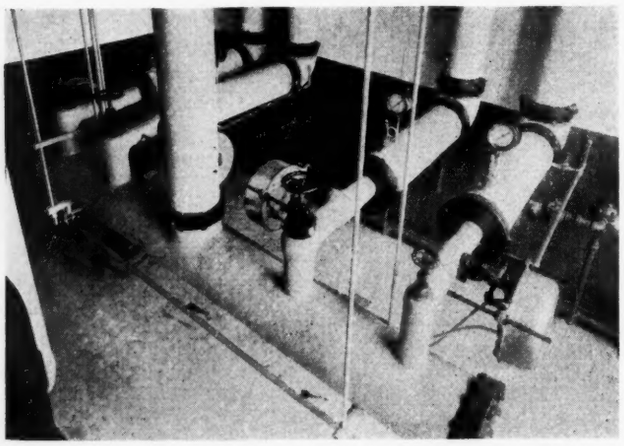


Fig. 2—Distribution header on fifteenth floor showing zone control mechanism

zone serves the radiators on these floors along the south and east wall. The two other zones similarly divide the building diagonally and supply radiators from the fifteenth down to and including those on the eighth floor.

Orifices installed in the union between the valve and nipple of all of the radiators in the zone system are designed so that with a definite maximum pressure just after the zone control valve only that steam will flow to the radiators which the radiators can condense. Since the radiator will condense all of the steam that can flow to it, there is no need for a trap at the outlet; consequently these have been eliminated throughout the zone heating system, resulting in a considerable saving in first cost of the system. At pressures below the maximum less steam will flow and the radiator will be partly heated. By controlling the steam pressure to any zone the heat delivered to it can be regulated as desired.

Automatic motor-operated reducing valves have been installed for each zone at the header in the fifteenth floor pump room as shown by Fig. 2 and also at the header in the steam meter room. These valves consist of a standard globe valve on the stem of which a special plug has been applied. The valve stem is attached through a coupling to the motor-operated control mechanism. The diaphragm of the control is connected to the steam main on the low pressure side of the valve and expands or contracts as the low-side pressure varies. Movement of the diaphragm makes electrical contacts to a small motor which operates to close or open the valve as required to maintain the desired pressure. The pressure at which the electrical contacts are made can be increased or decreased by turning graduated dials on a control board located in the building basement. Thus by changing the pressure setting of any zone control mechanism the pressure, and therefore the heat delivered to the zone, may easily be regulated by the engineer, and any degree of heating may be maintained in each of the five zones as required by building occupancy and outside weather conditions.

To assist the engineer in providing correct heating for the various zones, a long distance electrical temperature indicator has been placed on the control board. This instrument indicates the temperature at two points in each zone and an outside temperature for each zone.

A separate system was installed for the press room floor because it requires a somewhat higher temperature than that anticipated for the other manufacturing floors served by the upfeed zone of the orifice heating system. The heating system on this floor is supplied with 5-lb. steam which is controlled by air-operated valves at the inlet of each radiator. These valves are in turn regulated by wall thermostats.

A loading platform on the Forty-first Street side of the building is heated by two unit heaters located at opposite ends of the platform. Each unit is capable of delivering 350,000 B.t.u. per hour.

Returns from each of the top tower zones are collected on the fifteenth floor ceiling in two groups and carried through down corners to the basement. In the seventh floor ceiling return risers from radiators on the eighth to fifteenth floors, inclusive, are paired and join the returns from radiators on the lower floors, there being half the number of return risers from the lower floors as there are from the floors above the seventh.

The returns are collected in the basement in an 8-in. header which is vented through a 3-in. pipe. Thus

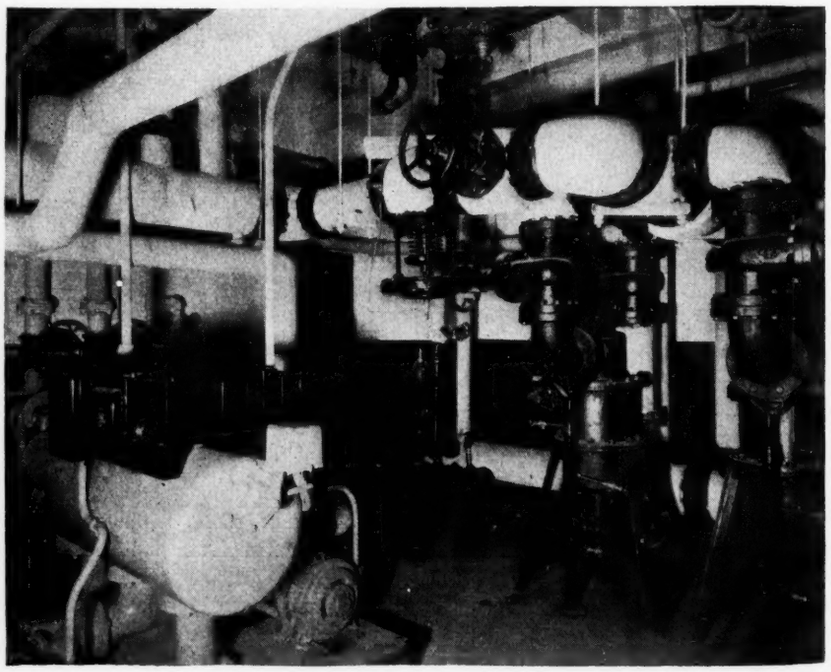


Fig. 3—The steam meters are shown at the right, the condensate pump in the left foreground and back of it the return header

atmospheric pressure exists in the return system. A condensate pump removes the returns from an 8-in. header, and discharges them through a preheater. The heating system risers are dripped through float traps to the radiator return lines. Drips from the high-pressure lines return through float traps direct to the preheater. Returns from the indirect heating of the executive floors, the basement and lobby heating systems, and hot water drips from the fifteenth floor hot-water heater, and the basement hot-water heater also return direct to the preheater. From the preheater the returns are wasted to the sewer.

From the eighth to the thirty-third floor, inclusive, two tube-type cast-iron radiators have been installed per bay. In the lower floors, second to seventh, only one wall-type cast-iron radiator has been installed per bay. It was possible to install only one radiator per bay in the factory floors, because few office sub-divisions are expected. This resulted in a considerable saving in installation cost, as it cut in half the number of inlet and return connections, and decreased the labor of hanging the radiators. Provision has been made in the branch piping so that the unit can be split in the future in case of office subdivisions.

From the eighth floor to the thirty-third, risers are concealed in the mullion, and the return lines in the column. From the seventh floor down, risers and return lines are concealed in the columns.

The water service is divided into a high- and a low-head system. The low-head system is served by a 12,000-gal. fire and house tank on the sixteenth floor. This tank is supplied by two low-head pumps of 250 gal. per minute capacity, and supplies outlets from the tenth floor down, and also a hot-water heater in the basement. The high-head system is served from an 8,500-gal. roof tank which is supplied by a 250-gal. pump. The roof tank supplies water to a hot-water heater in the fifteenth floor pump room. In addition to the heating system header, and water heater, this room contains a 750-gal. fire pump. A second fire pump of the same size is located in the basement.

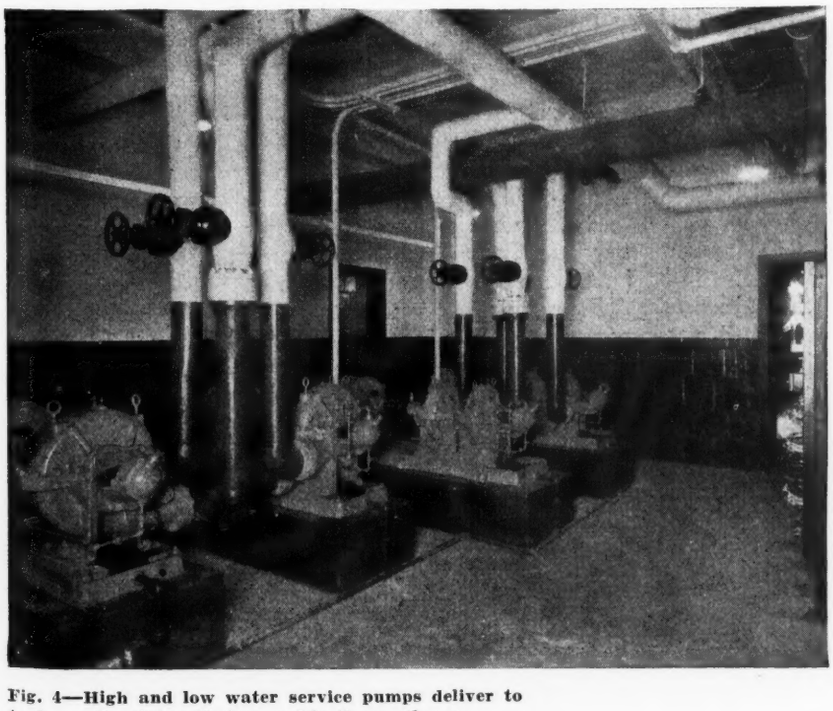


Fig. 4—High and low water service pumps deliver to tanks on the sixteenth floor and in the penthouse

The entire building is equipped with sprinklers, which are supplied by two 17,500-gal. gravity tanks on the fifteenth floor and a 20,000-gal. split tank on the roof. Two 5,000-gal. pressure tanks on the roof supply water at higher pressure for the upper floors. An 80-gal. pump in the basement has been installed to fill these two tanks. There are 8,000 sprinkler heads in the building.

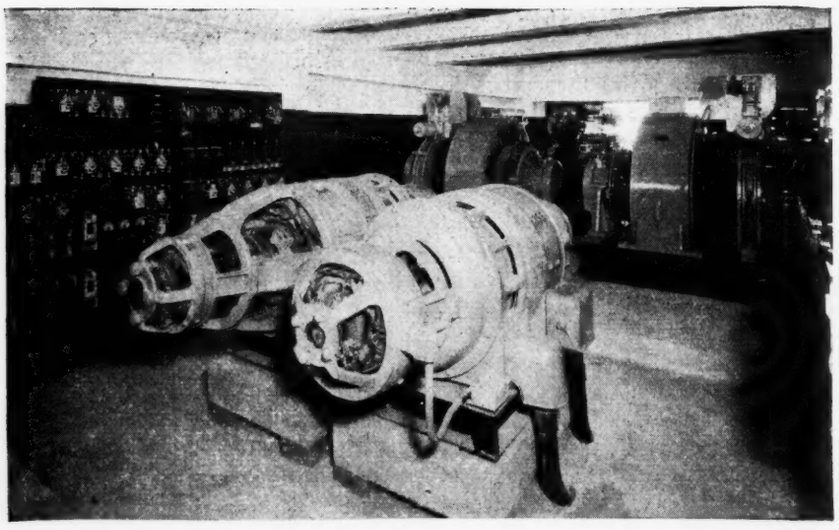
Ventilating has been provided for the executive offices on the thirty-second and thirty-third floors, lavatories and locker rooms throughout the building, elevator machine rooms, and the steam room and shop in the building base-

Fig. 5—Fans for ventilating the conference room are located in the penthouse

ment. Two lavatory and locker room exhaust systems have been provided with ducts that run the entire height of the building. The exhaust fans are in the lower level of the pent house, and each are of 10,000-c.f.m. capacity. Two ducts permit fumes from manufacturing processes to be exhausted to the roof. Fans for this purpose are to be installed by the tenants. The large conference room on the thirty-third floor has been provided with supply and exhaust ventilation. The supply fan has a capacity of 4,500 c.f.m. and discharges through air filters and heating coils to an opening in the rear of the conference room. The exhaust fan, of 3,700 c.f.m., removes air from the front of the room.

Exhaust ventilation has been provided for all three elevator machine rooms. A supply fan has been installed for the two machine rooms on the seventeenth floor. The arrangement of the ducts and fans may be seen in Fig. 1 of the next article. Supply air for the machine room in the penthouse is taken from outside through louvers, and for the low rise freight elevator machine room it is taken from the building space. Supply fans for the seventeenth floor machine room were installed to avoid noise from the elevators disturbing occupants on this floor.

Hood & Fouilhoux were the architects, Lockwood Greene, Inc., the engineers, and Starrett Brothers & Eken the builders.



Motor-generators and elevator machines for two of the five high-speed express elevators

Pliotron Tubes Level Elevators

IN McGRAW-HILL BUILDING

In the new 33-story McGraw-Hill Building there are nine passenger and five freight elevators, all of which are equipped with Pliotron leveling devices. The five express passenger elevators have automatic push-button control and the four locals are car-switch operated

PROVIDING vertical transportation is a major problem in every skyscraper. In the new 33-story McGraw-Hill Building the elevator problem was complicated because the building will serve both office and manufacturing purposes. All the publishing activities of the company in New York City will be centered in this building. The lower floors will be used for the mechanical departments and the upper floors will provide office space. Because the company will occupy a large part of the building, passenger elevator service had to be provided for a heavy interfloor travel in addition to the incoming and outgoing traffic. Provisions had also to be made for handling a large volume of heavy freight and a large daily incoming and outgoing mail, much of which is bulky.

Studies were made of different possible numbers of elevators and various arrangements of them. From these investigations it was decided that high-speed automatic-type elevators for the express service and a lower speed car-switch-operated type for the local service would be the most economical combination. The five high-speed express elevators operate at 800 ft. per minute. One of these serves all floors and can be used for night service and also for handling mail. The other four express passenger elevators serve all floors from the fifteenth to the thirty-third, inclusive. The four local elevators run at 600 ft. per minute and operate between the first and fifteenth floors. All the passenger elevators are of 3,500 lb. capacity and are in two banks. The local bank is arranged on either side of a cross lobby and the express cars are similarly placed in another cross lobby, Fig. 2. Many of the employees in the building will work on the lower floors, and if necessary during peak traffic periods they can use the freight elevators, which are actually heavy-capacity passenger machines.

Four freight elevators, two rated 8,000 lb. at 250 ft. per minute, serve from the first to the fifteenth floors and two, of 6,000-lb. capacity at 300 ft. per minute, operate between the first and the ninth floors. A special 4,000-lb., 50-ft. per minute freight elevator operates between the basement and the second floor. A type lift operates from the fifth to the seventh floor to handle type forms, electroplates and other materials between the composing and the press rooms. There is also a chute for delivering packages from the fifth floor to the loading platform.

The freight elevators are located back of one bank of local and a bank of express passenger cars, Fig. 2. On the ground floor they open onto the loading platform on the Forty-first Street side of the building.

On acount of the diversity of service that the elevators

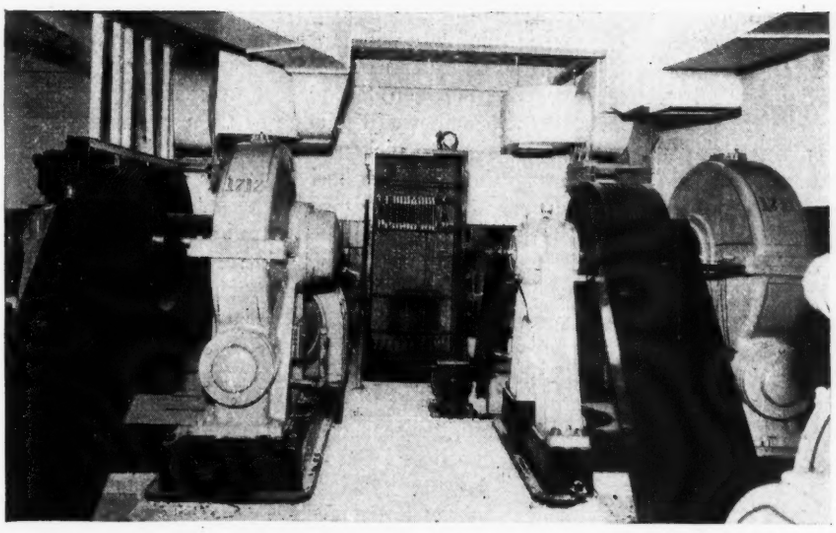


Fig. 1—The two high-rise freight elevator machines are rated 8,000 lb. and 250 ft. per minute and serve the first to the fifteen floors. They are of the worm-gear, V-groove traction-type with variable-voltage control and pliotron-tube automatic leveling equipment. This elevator room and that for the local passenger machines are force-ventilated. The supply and the exhaust fans can be seen above the the elevator machines

will be called upon to render, some of which could not be estimated closely, provisions have been made to install additional elevators along side the present banks. The framing of the structure is such that additional elevators may be installed along the west wall should future extensions be made to the building.

All elevators are equipped with a pliotron-tube type leveling device that automatically stops the cars level with the floors. On the express elevators the cars have bi-parting doors that open automatically as the car stops. On the local cars standard-type folding gates are used. The hoistway doors are opened manually and are closed automatically. Both the car gates and the hoistway doors are interlocked with the elevators' control, so that the car cannot leave a floor unless the doors and gates are closed and locked.

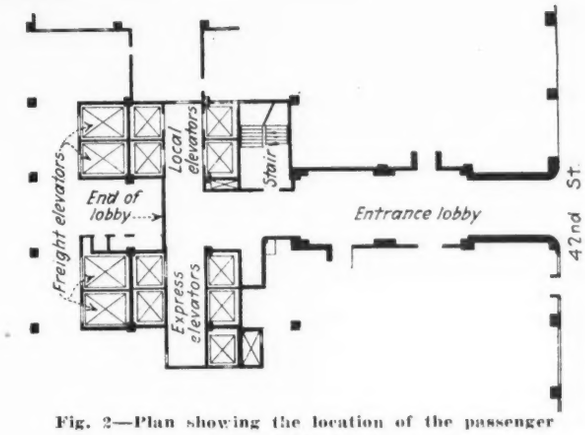


Fig. 2—Plan showing the location of the passenger and freight elevators

Express Passenger Elevators

The express passenger elevators are controlled automatically from push buttons in the cars and on the hoistway landings. Fig. 3 shows the operator's panel in one of the express cars. At the top of the panel is a bank of push buttons numbered according to the floors served by the car. As the passengers come onto the car and call their floors the operator presses buttons corresponding to the floor numbers called.

To start the car the hoistway door is released and the operator moves his lever to the full on position. This causes the car doors to close, and when they are closed the car starts and accelerates automatically to full speed, unless there is a stop call ahead of the car within one or two floors, in which case the car slows down for the stop at the proper point. Direction of motion of the elevator is determined by whether the operator's lever is thrown to right or left. The operator holds his lever in the full on position all the time the car is running, and thus has full control over the car, as he can make an emergency stop at any floor. When the car enters the first stopping zone for which a stop call has been previously recorded it slows down automatically, and afterward is stopped by the pliotron tube control, as shown below. As the car stops, the car doors open automatically and the operator centers his lever preparatory to another start.

Stop signals set up in the control by pushing buttons on the operator's panel in the car remain on until the car reaches the terminal landings, when they are cancelled automatically. If after making part of an up trip, the car is reversed and returned to the terminal landing, the signals on the operator's panel may be cancelled by pressing buttons *B*. The car will then answer down calls made from the landing buttons and from buttons pressed on the operator's panel. This button is also used to release the signals set up on the operator's panel if he makes a mistake and pushes a wrong button. By pressing button *B* all the signals on the panel are released, after which they may be set up correctly.

Buttons *F* cut the floor signals in or out and switch *S* does the same operation on the floor lanterns. If the car is coming down with a full load the operator presses the signal off button, which transfers the down calls from the landing buttons to the following car. The loaded car then answers only calls made by pressing buttons on the operator's panel. By throwing switch *S* to the off position the floor lanterns are cut out and will not be flashed when the car passes a floor. This prevents confusing the waiting passengers as when they may expect to have a car stop. If a car passes a floor without stopping it is also preferable that the waiting passengers do not know this, as it tends to create complaints about the elevator service.

Above the operator's lever switches *M* are used to stop and start the motor-generator set that supplies power to the elevator motor. Next to switches *M* is a red light to show the operator if the generator is running. *E* is an emergency stop switch which when pressed shuts off power and applies the brake, wherever the car may be. The switch alongside of *E* controls the car lights, and the hoistway and car-door contacts are bypassed by switches *D*. The leveling equipment may be cut out of service by

the switch next to *D*, so that the car may be stopped in any position as well as at the floor, such as when mechanics may be making adjustments. A fan switch *F*' is also provided, which controls a fan in the cab ceiling.

One of the interesting features of this control is the pliotron leveling equipment. A pliotron is composed of a filament, a grid and a plate circuit in proximity to each other, so that their fields couple if the grid coil is suitably tuned with a capacitor across it. The diagram of the circuits is shown in Fig. 5. The frequency at which the circuit oscillates is determined by the frequency of the tuned grid circuits. In the standard elevator unit the frequency is about 200 kilocycles.

Since the couple between the grid and plate coils is essential to maintain an oscillating current in the circuit, breaking the coupling will stop the oscillations. On the car-leveling unit Fig. 7, *P* is the pliotron tube and the grid and plate coils are mounted back of the unit as at *C*. Inserting a metal plate between the two coils prevents coupling of their fields and stops the oscillations of the circuit.

In an oscillating circuit of this kind a considerable change in plate current occurs when the circuit goes in and out of oscillation. This plate current will be low when the circuit is oscillating and high when oscillation ceases. If a relay coil is connected in series with the plate circuit and bypassed by a capacitor, the latter will pass current freely during the oscillating state, but the highly inductive relay coil will not pass radio-frequency. When a non-oscillating condition exists the capicator will not pass current, but the relay coil will. Therefore to cause the relay to close its contact all that is required is to put a metal plate between the grid and plate coils. Removing this plate will cause the relay to open.

The pliotron unit in Fig. 7 has approximately one inch of air space between the plate and grid coils, and $\frac{1}{16}$ in. radial movement of the edge of the vane between the coils is sufficient to pick up and drop out the relay. By connecting the relay properly into the control circuit it can be made to initiate the operation to slow down and stop the car level with the floors and automatically maintain it level. The number of pliotrons required depends upon the speed of the car and other conditions. On the high-speed elevators in the McGraw-Hill Building five pliotrons are used for slowing down the car and leveling it at the floors. Four of the pliotrons on top of one car is shown at *C*, Fig. 6. One of the metal vanes mounted in the hoistway, to break the couple between the grid and plates coils, can be seen at *M*.

With this leveling system no mechanical connection is made between the hoistway and the control equipment.

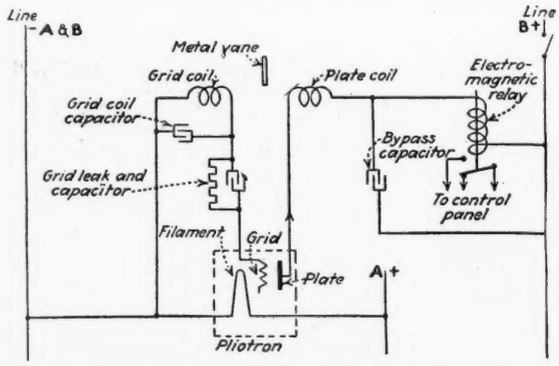


Fig. 5—Elementary connection diagram of a Pliotron elevator control system

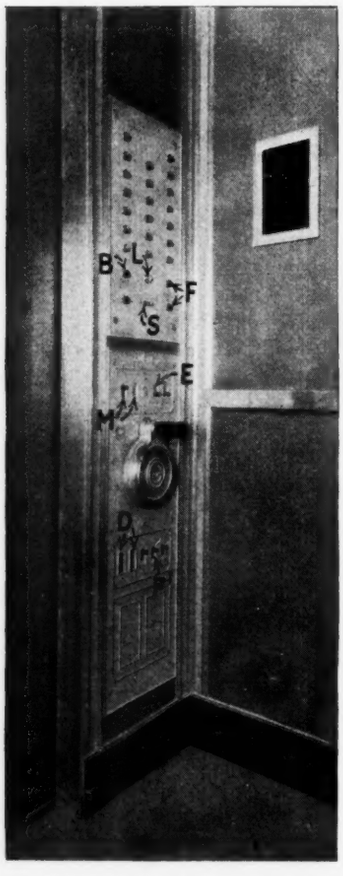


Fig. 3 (Left)—Car-operator's lever and push-button panel in one of the express passenger elevators

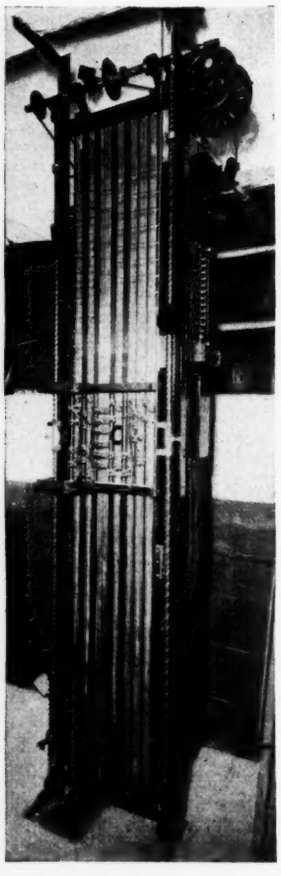


Fig. 4 (Right)—Floor selector that slows down the car before the Pliotron leveling equipment makes the final stop

Slowing down and leveling the car at the floors is done by metal vanes, located in the hoistway, passing through the space between the grid and plate coils of the pliotron units, which, in turn, cause relays to function to produce the slow-down and stopping operations.

The leveling operations are smooth, and transition from the first to subsequent speed is almost imperceptible. The final leveling-in to the floors is so gradual that the passengers are barely conscious of the change in speed until the car comes to rest and a landing is made.

Floor Selector Slows Down Car

Before the leveling systems acts on the high-speed cars they are slowed down by the signal machine or the floor selector, one of which is shown in Fig. 4. These selectors are located on a level below the machine-room floor. The contact carriage *C* is moved up and down over the stationary contacts by two vertical screws, one on each side, so that the carriage is rigidly supported and has no tendency to bind. The screws are driven from the secondary sheave on the elevator machine. A clutch is provided in the driving mechanism and any slight error due to rope creepage is corrected when the car passes a given point in the hoistway.

The selector determines the point in the hoistway at which the car begins to slow down, preparatory to stopping, after a button has been pressed in the car or on the landings to register a stop call. When the selector has slowed the car down the pliotron leveling device makes the final stop at the floor.

The car switch for the local elevators is similar to that on the express cars, except that in place of the operator's push-button panel there is a flashlight and a bell to indi-

cate the calls from waiting passengers on the landings. These cars are self-leveling similar to the express elevators. When the car is about one floor away from a stop the operator centers the car switch and the car is stopped level with the floor automatically.

An automatic speed regulator on the generator keeps the cars at normal speed at all loads. The controllers have automatic acceleration and retardation control that allows accelerating and slowing down the car at high rates without discomfort to the passengers. An important part of the control is a damping motor that governs the rate of building up and decay of the generators magnetic field. This damping motor is rated at $\frac{1}{4}$ hp. and has a flywheel on its shaft. It is connected across the generator field coils and does no work other than accelerate the flywheel.

When voltage is applied to the generator field coils the damping motor acts as an automatic bypass to control the rate of building up the generator's magnetic field.

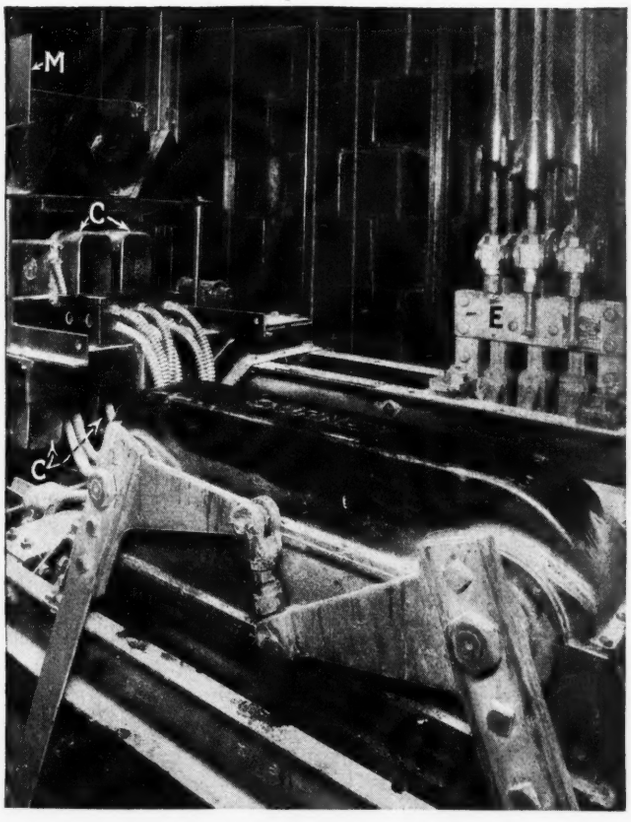


Fig. 6—Top of one of the express cars

In the foreground is the motor-driven car-door operator; the hoist-rope automatic equalizer is at *E*; four of the pliotrons for leveling the car at the floors can be seen at *C*; and one of the leveling vanes is at *M*.

With the motor stopped, when voltage is first applied it acts as a low resistance across the field coils. As the motor accelerates to full speed its counter-electromotive force increases and it becomes the equivalent of a high-resistance by-pass across the field coils. During retardation the damping motor becomes a generator and helps to retard the decay of the flux in the generator's field after voltage has been removed from the generator's field windings.

Another factor contributing to smooth operation of the cars is the heavy guide rails. On the high-rise cars $22\frac{1}{2}$-lb. guide rails are used. Previously passenger elevator cars have run on 15-lb. rails. The new heavy section

Fig. 7—A Pilotron unit with the tube at P and the grid and plated coils

gives unusually smooth riding qualities and an absence of side sway, vibration and noise.

All four freight elevators are car-switch-operated and are equipped for pliotron automatic leveling. The machines are of the worm-gear V-grooved type with variable-voltage control. The 4,000-lb. freight elevator, serving the basement and second floors, is push-button-controlled and requires no operator.

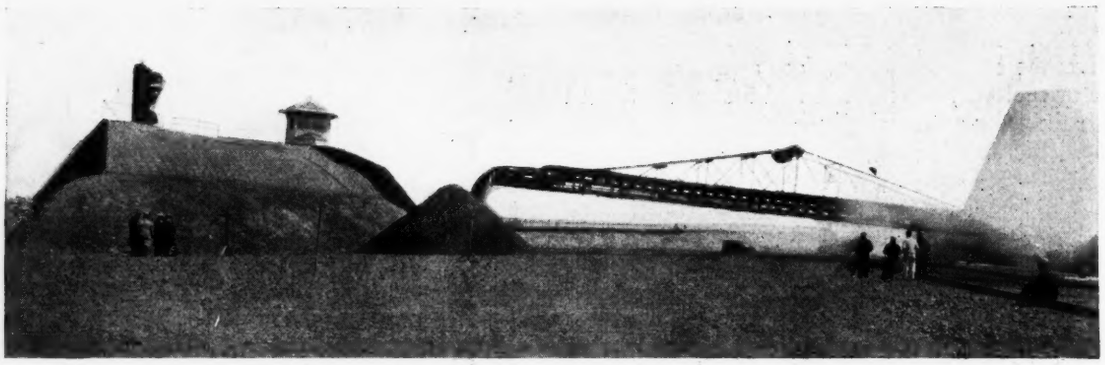
The elevator installation was made by the Gurney Elevator Company, using General Electric motors, motor-generator sets and control system, and Wagner Manufacturing Company signal fixtures. The elevator ropes were supplied by the American Cable Company; the equalizer on the hoisting ropes by the Evans Elevator Equalizer Company; cabs, the W. S. Tyler Company; hoistway doors, United Metal Products Company; and automatic guide-rail lubricators, O K Lubricator Company.

▼

Care of Renewal Parts for Electrical Equipment

A MACHINE or its parts are more likely to deteriorate when out of service than when in daily operation. This is particularly true of electrical equipment. Deterioration of mechanical parts is generally apparent, as indicated by rusting or other visible evidence. Such is not so with electrical equipment. An armature that has absorbed moisture until its coils are short circuited may, from all outside appearances, look in perfect condition.

It is not uncommon to find spare parts for electric equipment in practically a worthless condition when they are required for service. Coils should be stored in their original packing in a dry, well-ventilated room where the temperature is generally a few degrees above that outside. They should be inspected at least once a year for signs of deterioration. Spare armature or motors should be inspected and have their insulation resistance measured at least once a year. If the insulation resistance is found low the equipment should be dried out by baking to bring the insulation resistance back to a high value.



Unloading the first cargo of coal at Connors Creek

Moving Coal Cheaply From Dock to Car

To handle water-borne coal unloaded at dock by self-unloading vessels, the Detroit Edison Company adopted the gravel-pit system of loading platform with a trap door in connection with a drag-line scraper. From the dock front into a railroad car the cost of moving a ton of coal is slightly over 2c., including operating cost, maintenance and fixed charges

By J. R. JAMES
Engineer, Detroit Edison Co.

FOR SOME YEARS the Detroit Edison Company has been alive to the fact that a differential existed between the freight rate from the mine to Detroit, all rail, and from the mine to Lake Erie and thence by water to Detroit. However, there was, and still is, considerable controversy over the freight rates from mine to lake, and principally on this account the company hesitated to invest large sums of money to take advantage of this differential in freight rates favorable to water-borne coal.

Self-unloading vessels were scarce and rates were high, and to use other types of vessels incurred a large investment at the plant site for unloading equipment. In 1925, however, a company which for a number of years had been operating coal barges from Lake Erie through the St. Clair and Detroit Rivers, offered an attractive rate with a self-unloading vessel that they were about to build. The problem then remained to devise an inexpensive method of transferring the coal unloaded on the dock by the self-unloading vessel, either to the unloading pits in the plant or to stock piles in the yard.

Having in mind the method of loading wagons in out-of-the-way gravel pits by means of a trap door in a loading platform, the writer applied this scheme in connection with a drag line. The first installation was at the Marysville plant in 1926, at which time the company was pioneering in using such an arrangement for loading railroad cars with coal. From this installation several lessons were learned and later applied to a second installation at Delray in 1928, and to a third at Connors Creek in 1930. There are yet several refinements that can be made which will tend to increase the capacity for loading cars, but which can be postponed until the upper limits of demand are reached. The record so far is held by the Connors Creek plant, where 52 cars were loaded in seven hours.

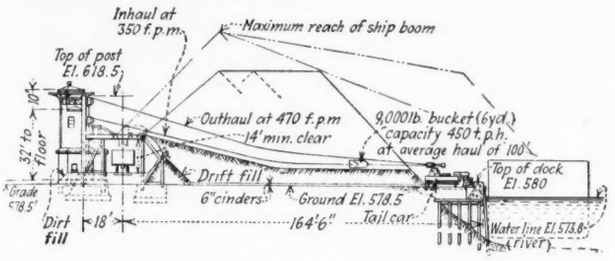
Once cars are loaded at the dock, the procedure of handling coal about the plant has not been changed from that when all coal came by rail. The only expense incurred then, in using vessel cargoes, is the cost of placing this coal into cars, and this brought out an interesting fact that it was no more expensive to load a car at the dock, unload it into stock and load out of stock, than it was to unload a foreign car into stock. In other words, here are three operations costing the same as one. This paradox may be explained in part by the fact that in a recently loaded car the coal is loose and more easily handled by a crane; also that as these are company cars they need not be cleaned out so well, and furthermore have no braces to interfere, as have many foreign cars coming into this district. The following figures indicate the cost of a typical installation not including the dock:

Tracks to dock	$5,700
Drag scraper equipment	38,500
Coal ramp	14,500
Total	$58,700

Should a project have no dock suitable for boat deliveries, the total cost of the project is influenced by its construction. There should be at least 400 ft. of dock front, costing somewhere between $160 and $250 per linear foot for a permanent type. This spring the Company completed at its Connors Creek plant a

wooden platform dock with concrete face at a cost of less than $160 per linear foot. Built of wood to avoid any question of patent infringement, this platform has stood up better than the concrete platform dock built at another plant, the maximum deviation of the face being less than 2 in., although loaded practically all the time since spring with from 12,000 to 20,000 tons of coal.

The drag scraper equipment is one of the largest built by the R. H. Beaumont Co., the bucket holding 6 cu.yd.

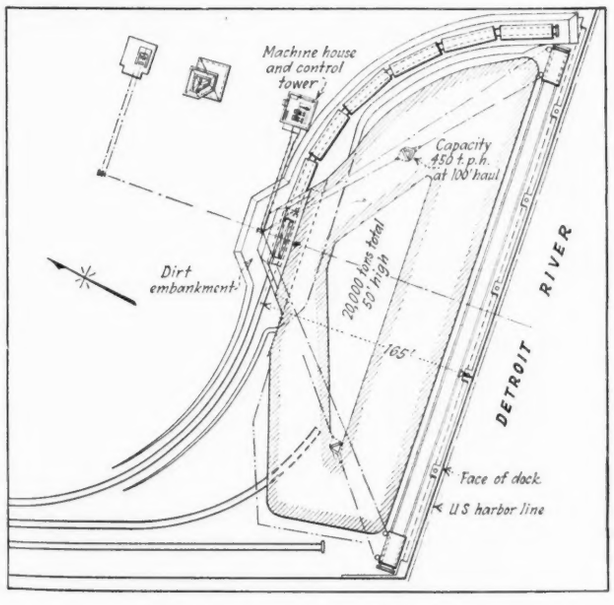


Section through coal-loading installation at Connors Creek station

of coal, equivalent to 9,000 lb. During the year 1930, coal to the amount of 230,000 tons was handled over the Marysville dock, with the following charges per ton:

Labor of operating drag line	$0.0068
Labor and material (maintenance)	0.0092
Fixed charges on $120,000 at 14 per cent	0.0073
	$0.0233

The section through the ramp at the dock front helps to visualize the operation of loading the coal into the cars. The tail car at the dock front is motorized so that it is possible for the operator in the tower to move it at will, thereby permitting him to line up the drag bucket in the best position possible and as often as necessary. The car has automatic rail clamps which secure the car to the rails immediately after each movement. The car weighs approximately 60 tons. The loading slot in the platform is sectionalized and equipped with gates. When the gates are open they act as skirt boards and tend to prevent spillage of coal on the tracks below. The head post is set well back of the center of the loading slot, so that, in case the bucket should overtravel, its bridle will not hit the sheave on the head post and as a result damage the cable. The operator is in a tower high enough to view the entire operation. He uses a hand controller to start and stop the drag bucket, and a button control for moving the rail car.



Plot plan showing general layout

The plot plan, illustrates the relationship of the operating tower, the loading platform and the tail car track. The track under the loading platform is on an upgrade out to the dock front of approximately 1.5 per cent, so that the empty cars will feed back as those in front are loaded.

Location of the center of the loading platform is determined by the position of the center of gravity of the pile of coal as deposited by the self-unloading vessel. It must be borne in mind that the capacity of the drag line falls off rapidly with increased length of haul. From the face of the dock to the center of the loading platform the distance shown, 165 ft., is about right when the unloading boom on the vessel reaches out 110 ft. from its side. The coal ramp is merely a housing over the railroad track supporting the loading platform and acts as a bulkhead against the coal pressure from the dock side. In the last installation, shown here, it was constructed of welded steel.

It so happened that at the Connors Creek plant coal dust proved a nuisance. This situation has been remedied by so placing 18 sprays operating at 80 lb. water pressure, as to envelop the coal falling from the unloading boom in a foggy mist. The photograph was taken at the occasion of the unloading of the first cargo of coal. It shows clearly the relationship between the boat, the tail car track, the ramp and the control house.

Induction Motors for Frequent Reversing

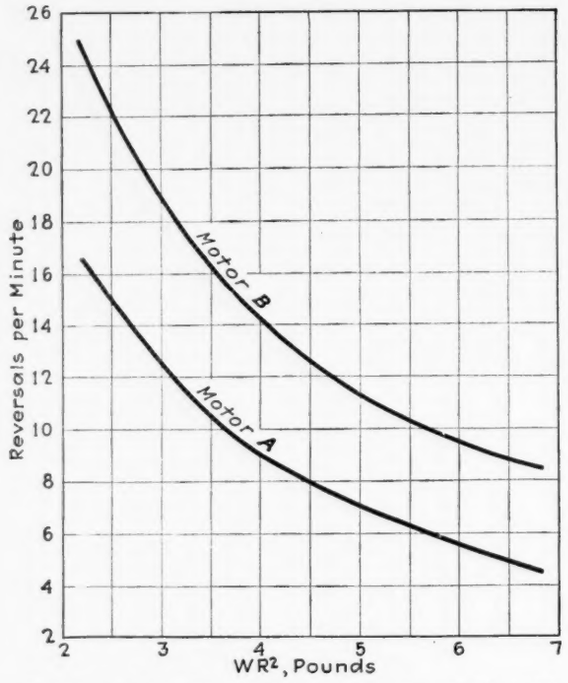
By R. F. EMERSON
Industrial Engineering Department
General Electric Company

WHEN a squirrel-cage induction motor drives a constant load at a constant speed it is not difficult to select a motor of the correct rating. Where a motor is required to make a certain number of starts or reversals per hour care should be taken in its selection, otherwise troubles may result from overheating. A squirrel-cage motor has an inrush current at starting which may be between 500 and 900 per cent of the full-load value. The greater the number of starts or reversals, the longer the time that this high current exists and the greater the heating of the motor.

A case in point which recently came to the writer's attention is a feeder conveyor delivering packages to a second conveyor. When a package drops on the second conveyor, the motor automatically starts, the package actuating the starting device. When the package has moved the required distance the conveyor automatically stops and does not start again until another package is delivered to it by the first conveyor. The frequency of starting depends on the number of packages coming through, and sometimes amounts to fifteen starts per minute. At this maximum only the most carefully selected motor would operate without overheating.

Sometimes a motor is used under somewhat similar conditions except that it runs continually and is required to be reversed a certain number of times per minute. If the motor is stopped by plugging the possibility of the motor's overheating is still greater, because the high

inrush current exists during "deceleration" as well as acceleration. The amount of dead load that the motor carries, also the inertia of the load, has an effect on the number of starts or reversals the motor can make. Because of its low power factor at low loads, the current taken by a squirrel-cage motor will be quite high compared to its full-load current, and there will not be as much reduction in heating for this reason as might be expected. With a motor fully loaded there is that much less torque available for acceleration, and because of the



Curves showing the number of reversals possible with 50 deg. C rise when using a general-purpose squirrel-cage motor A and a motor with a high-resistance rotor B

slower acceleration the high starting current lasts longer.

For example, the motor recommended for the previously mentioned conveyor had a total average torque of 24 lb. at one-foot radius. If the friction load of the conveyor is only 2 lb., it leaves 22 lb. available to accelerate the load, which would take 0.25 sec. If the friction load is 12 lb., it leaves only 12 lb. available for accelerating the conveyor, in which case it would take 0.46 sec. In other words, the high accelerating current will last nearly twice as long.

The inertia of the driven load should also be given careful consideration. If the driven load is of the nature of a heavy flywheel having considerable inertia it will have a very noticeable effect in dragging out the acceleration period. An increase of 100 per cent in the total inertia of the load will mean doubling the length of the acceleration period. In cases where a motor used on frequent reversing service is giving trouble due to overheating the following remedies may be considered:

1. If the driving motor is high-speed, check the WR_2 of a lower-speed motor and see if changing motors will help any. In cases where the inertia of the driven load is light the inertia of the rotor of the motor is sometimes a large percentage of the total. It is true that the inertia of a slower-speed motor is usually greater than that of a higher-speed motor, but the rotor of the slower-speed motor is not accelerated to as high a speed, and more is gained for this reason than is lost due to the heavier rotor. This can be easily calculated if the flywheel effects of the two rotors are known.

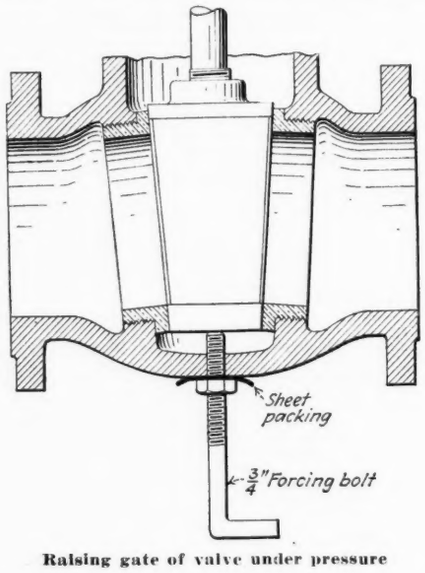
2. Sometimes a motor with a high-resistance rotor can be used in place of a general-purpose squirrel-cage motor. The curves show the number of reversals per minute obtainable with two motors built in the same frame and having similar rotors, except *A* is a general-purpose motor and *B* has a high-resistance rotor. For example, with WR_2 of 3 lb., motor *A* can average 12.4 reversals per minute without exceeding 50 deg. C. temperature rise, whereas *B* can make 19 reversals because of its lower current inrush.

3. In cases of very severe service a wound-rotor motor can be used with a permanent resistance connected across the collector rings. In this case most of the rotor heating is dissipated in the resistance external to the motor.

Gate Valve With Broken Stem Opened Under Pressure

By A. PULLEKINS

IN A PLANT having two centrifugal pumps supplying service water to a factory it was found that the valve stem of the gate valve on the discharge line of one of the pumps was broken. The discharges of the two pumps were connected to a common header with an 8-in.

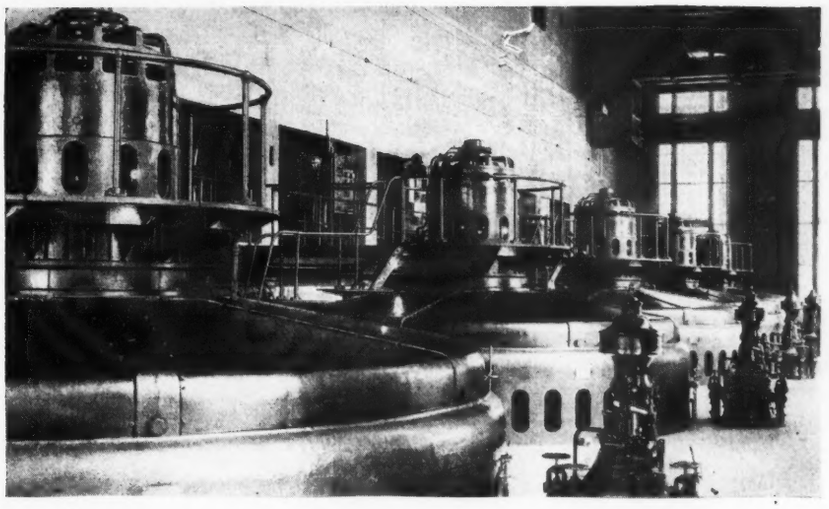


Raising gate of valve under pressure

solid wedge gate valve on the discharge of each pump.

Normal operation required the use of both pumps on the line during the week, and one pump only over the week-end. At the time the accident was discovered the first pump was already on the line and working, and it became necessary to put on the second pump because of water demand. The discharge valve stem being broken, it was not possible to open this valve, and the method shown in the sketch was resorted to as a ready means of raising the gate of the valve.

As shown, the method consisted of drilling and tapping a ¾-in. hole in the body of the valve under the gate. A long threaded bolt with a handle on the end for turning with a wrench was made out of ¾-in. cold-rolled steel. Packing was held against the body of the valve by a ¾-in. nut on this bolt so as to prevent leakage of water when the gate was forced from its seat. By backing out the broken valve stem the gate could be forced from its seat by screwing in the threaded bolt.



Twin Falls plant has five 4,500-kva., 13,200-volt, 60-cycle units installed

Paper Mill Reduces Steam Consumption 30 Per Cent Per Unit Production

The Abitibi Power & Paper Company has, by a program of improvements extending over several years, increased production 33 per cent in its Iroquois Falls pulp and paper mill and reduced the steam consumption 30 per cent per unit output. 75 per cent of the steam is now supplied by electric steam generators and refuse-burning boilers

By A. T. HURTER and G. L. STUART
Resident Engineer *Assistant Engineer*
Iroquois Falls Division
Abitibi Power and Paper Company, Ltd.

AT IROQUOIS FALLS in Northern Ontario is the Abitibi Power and Paper Company's 600-ton pulp and newsprint paper mill. This plant represents fifteen years of growth and development that has made it one of the most economical in operation. As first built, the mill had a capacity of 250 tons and all steam was supplied by coal-fired and refuse-burning boilers. In the present mill an average of 75 per cent of the steam for power, process and heating is obtained from refuse-burning boilers and electric steam generators, the latter supplied with low-cost hydro-electric power. When hydro developments now under construction are completed, the necessity for operating the coal-fired boilers will be practically removed.

The hydro-electric system from which the mill is supplied with power includes a storage on Lake Abitibi of about 350 sq.mi., Fig. 2, which can be controlled between high- and low-water marks, a depth of about 8.5 ft. Near the mouth of Abitibi Lake is Twin Falls plant with five 6,000-hp. vertical-shaft units operating under a 55-ft. head. This plant controls the flow from the lake. Ten miles by river and 4.5 miles in a direct line from Twin Falls is Iroquois Falls, where the pulp and paper mill is located. In the pulp mill twelve of the grinder lines are driven by 2,000-hp. waterwheels. Two lines are each driven by a 2,000-hp. waterwheel on one end of the shaft and an 1,800-hp. synchronous motor on the other end. Five other grinder lines are driven by 1,800-hp. synchronous motors.

About 80 mi. below Iroquois Falls is Island Falls plant, with four 12,000-hp. vertical-shaft turbines that operate under a 62-ft. head. At Abitibi Canyon, 25 mi. below Island Falls, a 275,000-hp. plant is being constructed by the Ontario Power Service Corporation, a subsidiary of the Abitibi Power and Paper Company. This plant will be ready for initial operation in October, 1932.

Sixty-cycle 13,200-volt power is generated at Twin Falls plant and is transmitted at that voltage over a double line 5 mi. long to Iroquois Falls. The Island Falls plant was built by the Hollinger Consolidated Gold Mines, Ltd., and when acquired by the Abitibi company had two 25-cycle, 12,000-hp. units installed. To complete this installation, two 60-cycle, 12,000-hp. units were added to operate in parallel with the Twin Falls plant.

In the Abitibi Canyon plant 25-cycle power will be generated. This frequency was adopted to supply power to the 25-cycle system of the Ontario Hydro-Electric Commission's system, for which the company has a 100,000-hp. contract. There is sufficient 60-cycle capacity in the other plants on the system to take care of future

needs for power at that frequency in the pulp and paper mill.

All excess power will be used in electric boilers for steam generation and either frequency is suitable for these units. One of the three electric boilers in the mill is now equipped so that it may be switched for operation on either the 25- or 60-cycle system. Power at either frequency is delivered to the mill's busbars at 12,000 volts, the voltage at which the electric boiler operates. It is therefore only a matter of installing the necessary switching equipment to operate the boilers on either 25- or 60-cycle power.

Sixty-cycle power from Twin Falls plant, as previously mentioned, is transmitted at generator voltage to the paper mill and is delivered to the 12,000-volt bus. At Island Falls plant the 60-cycle power is stepped up to 120,000 volts by three 6,000-kva. transformers connected delta-star. A single 60-cycle transmission line runs to Iroquois Falls and connects through a bank of star-delta transformers to the 12,000-volt bus with the Twin Falls plant. Twenty-five cycle power from the Island Falls plant is stepped up to 120,000 volts by a bank of three 8,000-kva., delta-star connected transformers and transmitted to the mill over a single line. This line is carried on the same towers as the 60-cycle line. At the mill the 25-cycle power is stepped down to 12,000 volts through a bank of star-delta-connected transformers and goes to the electric steam-generator bus.

All mill power and lighting loads are supplied from the 60-cycle bus. Power for the mill load is stepped down from 12,000 to 600 volts through a bank of three 5,000-kva. transformers. The grinder room and block-pile loads are served at 600 volts from a bank of three 2,000-kva. and a bank of three 1,750-kva. transformers. These transformers are connected delta-delta and to a bus from which the feeders run to the different departments. All of these transformers and their switching equipment are of the indoor type and the transformers are water-cooled. A one-line diagram of the power system is shown in Fig. 1.

Large quantities of steam at different pressures are required for the digesters, for the paper-machine engines, for paper drying, for mill heating and other purposes. To supply this steam there are available the electric steam generators already mentioned, ten 4,780-sq.ft. coal-fired boilers, two 3,580-sq.ft. and four 4,780-sq.ft. refuse-fired boilers. All the boilers operate at 150 lb. gage, 125 to 140 deg. F. superheat and are equipped with econo-

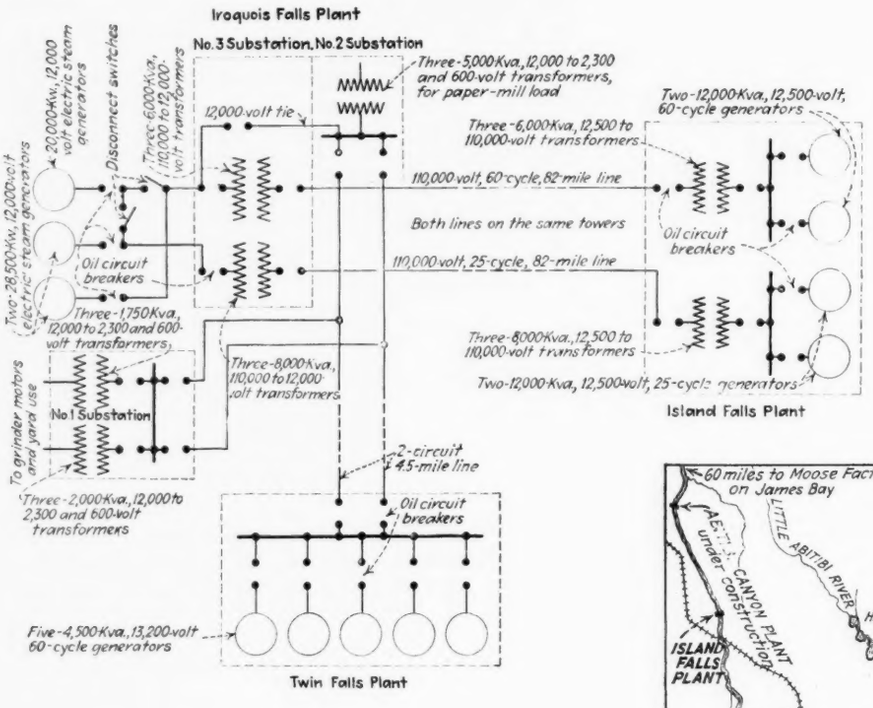
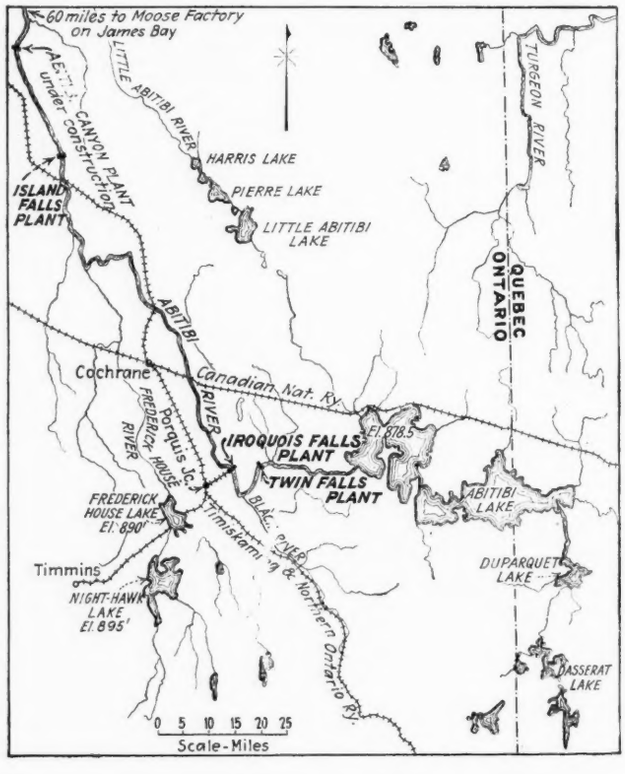

Iroquois Falls Plant
No. 3 Substation, No. 2 Substation
Three-5,000-Kva., 12,000 to 2,300 and 600-volt transformers, for paper-mill load
12,000-volt tie
Two-20,000-Kw., 12,000-volt electric steam generators
Disconnect switches
Three-6,000-Kva., 110,000 to 12,000-volt transformers
Two-12,000-Kva., 12,500-volt, 60-cycle generators
Three-6,000-Kva., 12,500 to 110,000-volt transformers
110,000-volt, 60-cycle, 82-mile line
Both lines on the same towers
Oil circuit breakers
110,000-volt, 25-cycle, 82-mile line
Two-28,500-Kw., 12,000-volt electric steam generators
Three-1,750-Kva., 12,000 to 2,300 and 600-volt transformers
Three-8,000-Kva., 12,500 to 110,000-volt transformers
Three-8,000-Kva., 110,000 to 12,000-volt transformers
Two-12,000-Kva., 12,500-volt, 25-cycle generators
Island Falls Plant
To grinder motors and yard use
No. 1 Substation
2-circuit 145-mile line
Three-2,000-Kva., 12,000 to 2,300 and 600-volt transformers
Oil circuit breakers
Five-4,500-Kva., 13,200-volt 60-cycle generators
Twin Falls Plant

Fig. 1—Single-line diagram of the electric power system supplying Iroquois Falls mill. In addition to the two hydro plants shown in the diagram, fourteen 2,000-hp. waterwheels drive wood grinders at the mill

Fig. 2 (Below) — Map shows the Abitibi River and location of the Abitibi Power and Paper Company plants. The capacity of these plants is given on Fig. 1



mizers. The boilers are set in pairs and each pair is served by one economizer.

Normally two electric steam generators, the refuse-burning boilers and three to five coal-fired boilers are required in service. Electric steam generators are not adapted to supplying fluctuating loads. As there is no accumulator, these are operated in parallel with the fuel-fired boilers to take the peak demands. It has been found that the best results are obtained from the refuse-fired boilers when operating on constant load at about 100 per cent rating.

The refuse for firing the boilers is available for two 8-hr. periods per day with a 3-hr. interval between.

There is also an hour in the middle of each 8-hr. shift when refuse is available in reduced quantities. To take care of these off periods of the refuse-burning boilers and to supply the peak steam demands is the chief function of the coal-fired boilers during normal operation. These boilers are also available to supply steam in emergencies when an electric boiler happens to be down, and in times of low water when there is not sufficient power for electric steam generation. The coal-fired boilers are stoker-fired and are operated up to about 150 per cent rating. They have an average daily efficiency of 79.5 per cent. All banking losses are included in the efficiency calculations. If a boiler is banked the coal burned by it is charged against those that are steaming. The meters and coal scales are carefully checked and every effort is made to obtain accurate results.

The six refuse-fired boilers are also equipped to be coal-fired, with underfeed stokers. Refuse consisting of bark, sawdust, waste wood and rejected pulpwood is burned in a Dutch-oven type furnace, Fig. 3. It is fed through the top of the furnace directly onto the stoker. These boilers are equipped with forced- and induced-draft fans, as are the other boilers, and are normally operated at about 100 per cent rating. If the refuse is unusually wet it may be necessary to start the stokers and add some coal to help burn the refuse. The refuse-fired boilers are not used for coal-burning (except as previously mentioned), as it is never necessary and the furnaces are not suited to this service. During the winter there is more and better refuse than in the summer. In the former period burning refuse saves about 55 tons of coal per day and during the latter about 35 tons.

Fig. 3 (Right) — Cross-section through one of the refuse-fired boilers and its furnace. The refuse-burning furnaces are equipped with stokers so that coal may be added to help burn the refuse if it is unusually wet

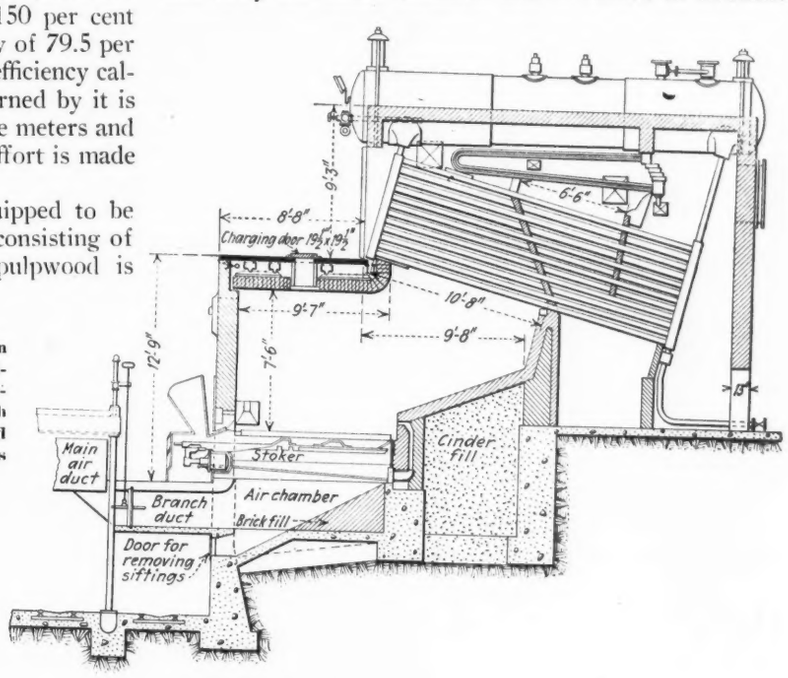


Fig. 4 (Below) — Cross-section through thermo-compressor that uses high-pressure steam to draw steam from a low-pressure main and delivers it at an intermediate pressure to the paper-machine driers

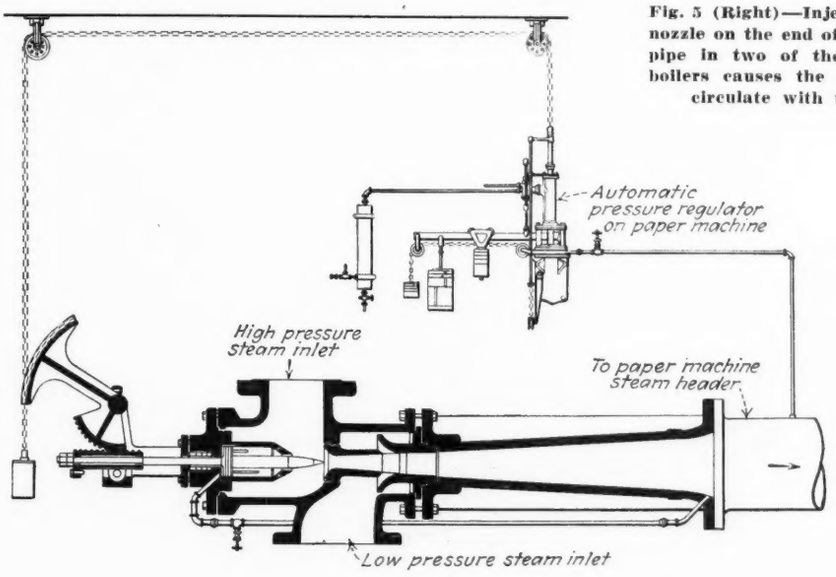
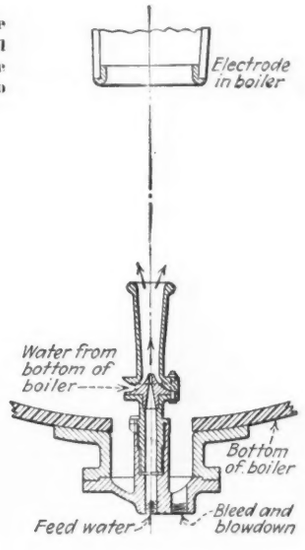

Automatic pressure regulator on paper machine
High pressure steam inlet
To paper machine steam header
Low pressure steam inlet

Fig. 5 (Right)—Injector-type nozzle on the end of the feed pipe in two of the electric boilers causes the water to circulate with them



Two of the electric steam generators are rated at 20,000 kw. and may be loaded up to 28,500 kw. These units have three vertical tanks per generator, one for each phase, with a single electrode. Manual control of the feed water and bleeding is used and the steaming rate is regulated by the depth of electrode immersion and the amount of concentrate in the water.

Feed water to these boilers is supplied at a rate determined by the steam demands and is caused to circulate within the boiler by an injector-type nozzle on the end of the feed pipe in each drum, Fig. 5. This injector was developed at the Iroquois Falls plant and has been patented in Canada and the United States by Karl O. Elderkin.

In electric steam boilers, working without forced circulation, the hottest water containing the larger proportion of the impurities in suspension and solution, stays at the top and the colder water tends to remain at the bottom of the boiler. It is necessary that a certain amount of the impurities coming into the boiler with the feed water be drawn off by bleeding to insure proper operation. This bleeding is done from the bottom of the

boiler, consequently a comparatively large amount of water must be bled to keep down the impurities to a given value. It also requires taking into the boiler a like amount of feed water above that converted into steam. Causing the water to circulate in the boiler, the impurities in solution will be evenly distributed and a smaller amount of water will have to be removed to maintain a given concentration. Bleeding becomes practically 100 per cent effective, as the tendency for short circuiting of the incoming feedwater directly to the bleed is avoided.

The injector is attached to the feed water pipe and is surrounded by a throat which communicates with the water in the bottom of the boiler, as indicated in Fig. 5. The feed water is forced through the jet in the usual manner and draws the water in the boiler through the throat into the nozzle circulating it rapidly within the boiler. The water is therefore kept at a more even temperature than in boilers without a jet. Although the temperature of the bleed water will be higher, the increased impurities in it will require bleeding a smaller amount to maintain the desired concentration.

The third electric boiler is rated at 20,000 kw. and is of the forced-circulating type, with a motor-driven pump. It is of the single-drum type, with three electrodes in a single shell. The control of this boiler is also manual. Steam at 155 lb. gage is taken from these boilers through tangential-type separators and goes to a vertical receiver connected to the high-pressure steam line from the fuel-fired boilers.

Superheated steam is desirable for the paper-machine engines and is normally supplied from the fuel-fired boilers. The line to the engines is connected into the steam headers in such a way that they have the first demand on the superheated steam, as indicated in Fig. 7. The electric steam boilers are connected into the steam headers so that their steam goes to the paper-machine driers. Superheated steam from the fuel-fired boilers, available above that required for the paper-machine engines, mixes with steam from the electric boilers and goes to the sulphite mill. The amount of superheat in this steam depends upon the amounts of steam from the two sources.

A program of improvements has been carried out that has increased production about 33 per cent, improved the heat balance to where all low-pressure steam is utilized, and the steam consumption per ton of product has been decreased about 30 per cent. This mill, which was designed for a normal capacity of 450 tons of newsprint, now has a daily output of 600 tons. Increasing the speed of the paper-machine required increasing the steam pressure in the paper-machine driers. In the present set-up, drier pressures as high as 15 lb. are used when the exhaust pressure in the main is from 0 to 5 pounds.

Four of the paper machines are driven by vertical compound engines, two by electric motors, and the seventh by either an engine or a motor, the latter being usually used. Normally the engines would exhaust directly to the machine driers against the back pressure in

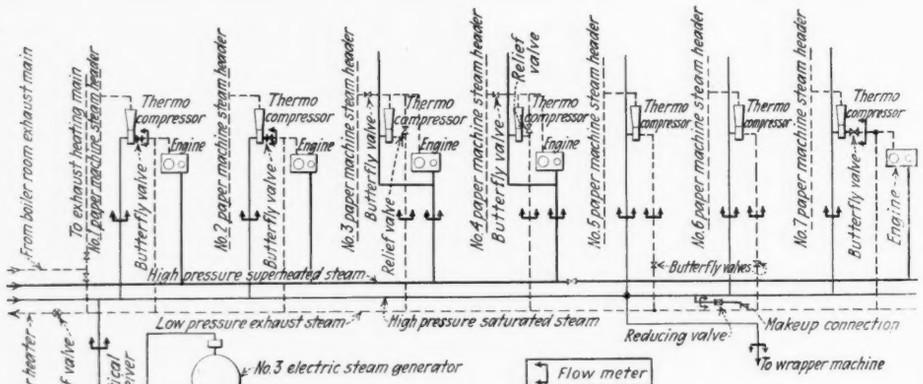


Fig. 6—Simplified diagram of steam piping to the paper machines. There are three sources of steam to these machines: high-pressure superheated from the fuel-fired boilers, high-pressure saturated from the electric steam generators, and low-pressure from various engines in the boiler room and in the mill

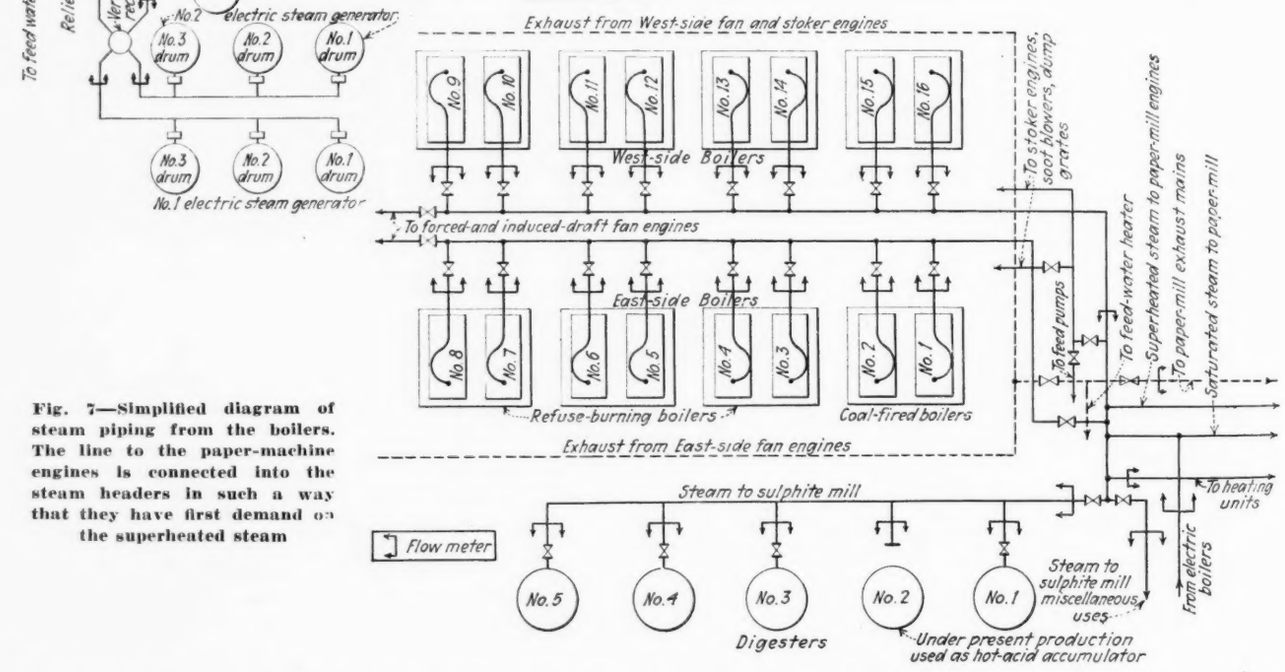


Fig. 7—Simplified diagram of steam piping from the boilers. The line to the paper-machine engines is connected into the steam headers in such a way that they have first demand on the superheated steam

them. With three of the engines, because of increased speed and load, best operation is obtained by having them exhaust against the low back pressure of the exhaust main.

To take care of the various conditions of low exhaust pressure; high drier pressures, with some engines exhausting to the driers and others to the exhaust main, also to meet the different requirements of engine and motor drives on the paper machines and, at the same time, use all available low-pressure steam, thermo-compressors have been used. A cross-section of one of these thermo-compressors is shown in Fig. 4. This piece of equipment may be considered to be an injector that uses high-pressure steam to draw steam from a low-pressure main and deliver it at an intermediate pressure to the driers.

The diagram, Fig. 6, shows the three conditions under which low-pressure steam is supplied to the paper-machine driers. There are three sources of steam supply to the machines; high-pressure superheated steam for the engines, high-pressure saturated steam for use in the thermo-compressors, and low-pressure exhaust steam. All low-pressure exhaust steam from the stoker engines, forced- and induced-draft fan engines in the boiler room and ventilating-and-heating equipment engines in the paper mill is supplied to the low-pressure main going to the paper machines. If there is a deficiency of exhaust steam, a reducing valve between the saturated and the low-pressure main admits steam to the latter.

With the hook-up shown on paper machines Nos. 1, 2 and 7, Fig. 6, the engine exhaust is connected to the low-pressure inlet of the thermo-compressor and to the exhaust main, consequently the back pressure on the engine

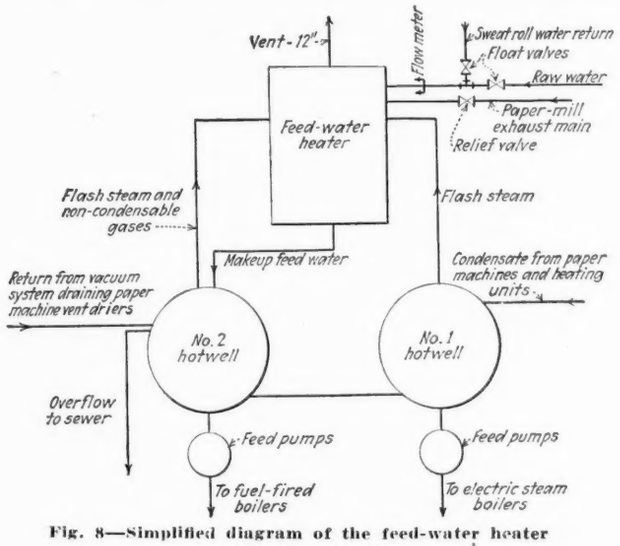


Fig. 8—Simplified diagram of the feed-water heater and hotwell hookup

is that in the exhaust main or slightly less. Steam from the high-pressure saturated line passing through the thermo-compressor picks up the low-pressure exhaust steam and supplies the mixture to the driers at whatever pressure is required. Any low-pressure steam required above the engine exhaust is supplied through the connection to the low-pressure main. When there is an excess of engine exhaust it goes to the low-pressure main to be used in other machines. With this hook-up the thermo-compressor must have sufficient capacity to supply all the steam to the driers.

The hook-up on paper machines Nos. 3 and 4 is used where the engines exhaust directly to the driers. Here the thermo-compressor is connected as a bypass around the engine and supplies the steam to the driers required above that from the engine. When the engine is running and the steam is not used in the driers a butterfly valve in the line to the driers and the nozzle in the thermo-compressor is closed, allowing the exhaust from the engine to blow back through the thermo-compressor to the low-pressure main. There is a bypass with a relief valve around the thermo-compressor that opens if the exhaust pressure reaches 3 or 4 lb. above drier pressure. With this hook-up the thermo-compressor requires only sufficient capacity to supply make-up steam required over that coming from the engine's exhaust.

The thermo-compressor hook-up used on the motor-driven paper machines is indicated on Nos. 5 and 6. In

Recording Instruments in Boiler Rooms, Sulphite and Paper Mills

Fuel-Fired Boilers

No	Type	Use
1	Pressure gage	Exhaust pressure.
2	Pressure gage	Steam-main pressure.
3	Thermometer	West-side boiler-header steam temp.
4	Thermometer	Steam temperature to paper-machine engines.
5	Flow meter	High-pressure steam to heating system, ponds, etc.
6	Flow meter	Steam from electric boilers to paper mills.
7 to 22	Boiler meters	Steam flow, air flow, flue-gas temp., and ind. over-fire draft for boilers No. 1 to 16.
23	Thermometer	West-side boilers' flue-gas temperature entering induced-draft fans.
24	Thermometer	East-side boilers' flue-gas temperature entering induced-draft fans.
25	Thermometer	Feed-water temperature to electric boilers.
26	Thermometer	Feed-water temperature to coal and refuse-fired boilers.
27	Pressure gage	Feed-water pressure.
28	Flow meter	Feed water to west-side boilers.
29	Flow meters	Feed water to east-side boilers.
30	Flow meter	Supplementary to No. 29.
31 to 38	Thermometers	Feed-water temperature leaving economizers No. 1 to 8 and entering boilers No. 1 to 16.
39	Flow meter	Total steam flow from west side boilers.
40	Flow meter	Exhaust steam from boiler house auxiliaries to paper mill exhaust main header.
41	Flow meter	Raw-water makeup to hot wells.

Sulphite Mill

No.	Type	Use
1	Pressure gage	Steam pressure to mill.
2	Thermometer	Steam temperature.
3	Flow meter	Steam to miscellaneous uses.
4	Flow meter	Total cooking steam.
5 to 8	Flow meters	Steam to each digester

Paper Mill

No.	Type	Use
1	Thermometer	Temperature high-pressure superheated steam.
2	Flow meter	High-pressure saturated steam to thermo-compressor on No. 1 machine.
3	Flow meter	Exhaust steam to thermo-compressor on No. 1 machine.
4	Pressure gage	No. 1 machine drier pressure.
5	Flow meter	High-pressure saturated steam to thermo-compressor on No. 2 machine.
6	Flow meter	Exhaust steam to thermo-compressor on No. 2 machine.
7	Pressure gage	No. 2 drier pressure.
8	Flow meter	High-pressure superheated steam to engine and thermo-compressor on No. 3 machine.
9	Flow meter	Exhaust steam to thermo-compressor on No. 3 machine.
10	Pressure gage	No. 3 machine drier pressure.
11	Flow meter	High-pressure superheated steam to engine and thermo-compressor on No. 4 machine.
12	Flow meter	Exhaust steam to thermo-compressor on No. 4 machine.
13	Pressure gage	No. 4 machine drier pressure.
14	Thermometer	Temperature of high-pressure saturated steam.
15	Flow meter	High-pressure saturated steam to thermo-compressor on No. 5 machine.
16	Flow meter	Exhaust steam to thermo-compressor on No. 5 machine.
17	Pressure gage	No. 5 machine drier pressure.
18	Thermometer	Temperature of exhaust steam main.
19	Pressure gage	Pressure or vacuum in exhaust-steam main.
20	Flow meter	High-pressure saturated steam to thermo-compressor on No. 6 machine.
21	Flow meter	Exhaust steam to thermo-compressor on No. 6 machine.
22	Pressure gage	No. 6 machine drier pressure.
23	Flow meter	High-pressure saturated steam to thermo-compressor on No. 7 machine.
24	Flow meter	Exhaust steam to thermo-compressor on No. 7 machine.
25	Thermometer	Temperature of exhaust steam to No. 7 thermo-compressor.
26	Pressure gage	Drier pressure No. 7 machine.
27	Flow meter	High-pressure saturated steam to wrapper machine.
28	Flow meter	High-pressure saturated steam to low-pressure exhaust steam through make-up connection.

Electric-Boiler House

No.	Type	Use
1	Thermometer	Feed-water temperature.
2	Pressure gage	Steam pressure.
3	Flow meter	Steam from No. 2 boiler.
4	Flow meter	Steam from No. 1 boiler.
5	Flow meter	Steam from No. 3 boiler.
6	Flow meter	Steam from No. 1, 2 and 3 boilers.
7	Flow meter	Feed-water flow to boilers.

this combination all steam to the driers is supplied by the thermo-compressor from the low-pressure and the high-pressure lines. The high-pressure steam being used to deliver the low-pressure steam to the driers at the necessary pressure for operating conditions. In all three hook-ups the thermo-compressor acts as a reducing valve, with the added feature of picking up low-pressure steam from the exhaust main. All the thermo-compressors are controlled by an automatic regulator, Fig. 4, on the paper machines to give the required pressure in the driers. This pressure is readily adjusted by the paper-machine operator, simply by increasing or decreasing the weight on the regulator's lever.

All condensate from the paper-machine driers, heating units and other sources is trapped and returned to the electric steam boiler hotwell as indicated in the diagram, Fig. 8. Any surplus of condensate above that required for feed water in the electric boiler goes to the hotwell for the fuel-fired boilers. If there is a deficiency of condensate for the electric boilers it is made up from the fuel-fired boilers' hotwell. The feed-water heater is located above the hotwells and the make-up water going to it consists of water from the sweat rolls on the paper machines and raw feed water. The water from the sweat rolls has a temperature of 70 deg. F., and considerable heat is saved by the recovery of this water, particularly in the winter when the raw-water temperature is around 34 degrees.

The condensate is returned at a temperature above 212 deg., consequently there is considerable flash steam from the hotwells. This steam goes to the feed-water heater to heat the make-up water. Control of the make-up water is by two floats in No. 2 hotwell. One of these floats controls a valve in the sweat-roll water line and the other operates a valve in the raw-water line. The floats are so arranged that the raw-water valve remains closed as long as there is sufficient sweat-roll water for make-up, of which there is generally more than enough. The exhaust main connects to the feed-water heater through a relief valve, but as there is rarely a surplus of exhaust steam above that required in the mill, heating the feed water is by flash steam from the hotwells. The heat balance for the entire plant has been so worked out that all exhaust steam is used for heating and drying and all available condensate is returned to the hotwells.

A very complete metering system is provided, so that the plant is operated under practically test conditions at all times. The location of the principal steam-flow meters is shown in Figs. 6 and 7, and a partial list of the meters is given in the table. Daily, weekly, monthly and annual reports are compiled. The daily reports provide a check on the plant's operation from day to day. In this way any defects in operation are detected almost immediately and corrected. The weekly, monthly and annual reports serve the accounting department to allocate charges to the different departments and to determine the production costs.

The authors extend their thanks to H. J. Buncke, chief engineer, Abitibi Power and Paper Company, in Toronto; and E. M. Little, assistant mill manager of the Iroquois Falls Division, for their assistance in the preparation of this article.

▼ ▼ ▼

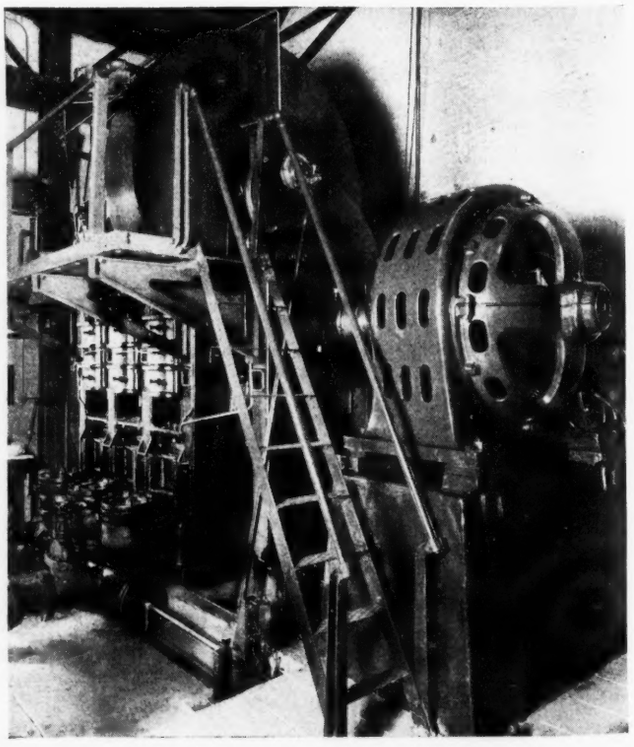
Synchronous-Motor-Driven Pump Equipped With Unloader

A SYNCHRONOUS MOTOR drive for a triplex reciprocating pump equipped with an automatic unloader, which works in conjunction with the motor control to unload the pump automatically, was recently installed by the Electric Machinery Manufacturing Company. The motor is rated 250 hp. at 720 r.p.m. and the unloader is of the Holveck type.

Without the unloader the pump must be unloaded manually by an operator, and manually loaded when the motor is up to speed and synchronized. With the automatic unloader, working in conjunction with frequency-responsive control, the entire starting operation is made automatic it being necessary only to push the start button.

A magnetic solenoid operating a pawl, controls the rotation of a cam shaft for holding open the suction valves. The lifting cams are operated by a rod connected eccentrically to the pump crankshaft. When the solenoid is de-energized the cams are so rotated that the suction valves are held open during the normal pumping stroke. When the solenoid is energized the cams are rotated away from the suction valve lifts and stopped to permit regular pump operation.

This unloader for synchronous-motor driven reciprocating pump permits continuous operation without attention, regardless of momentary power dips which would otherwise shut down the pump. It simplifies starting and makes possible automatic start and stop operation to maintain the desired liquid level or pressure in the tank.



Reciprocating pump equipped with automatic unloader is driven by a 250-hp. synchronus motor and is started and stopped automatically

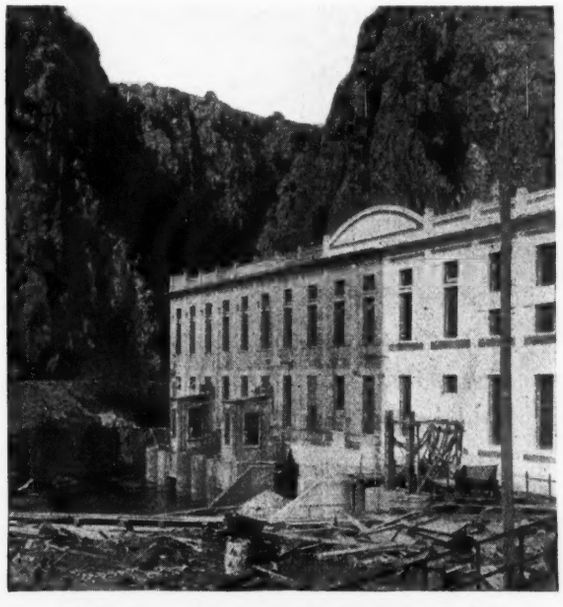
Electric Power Supply Expanding in Yugoslavia

By NIKOLAY VON KOTSCHUBEY
Zurich, Switzerland

GREAT EFFORTS have been made in Yugoslavia since the war to improve the production and distribution of electric power. Several large power stations have been built by municipalities as well as under government control. A number of private companies, chiefly foreign interests, have plants supplying electric current to large towns and to the Yugoslavian chemical industry.

Among the latter the Kralyevac water-power station, shown in the figures, should be mentioned. This plant belongs to a French company, which uses the largest part of the power in its chemical works on the Adriatic shore. A small part of the power is supplied to the city of Split. The power house, on the Cetina River, forty miles from Split, includes two 16,000- and two 25,000-kva. generating units. Power is transmitted to the substations through a fifty-mile over-head line.

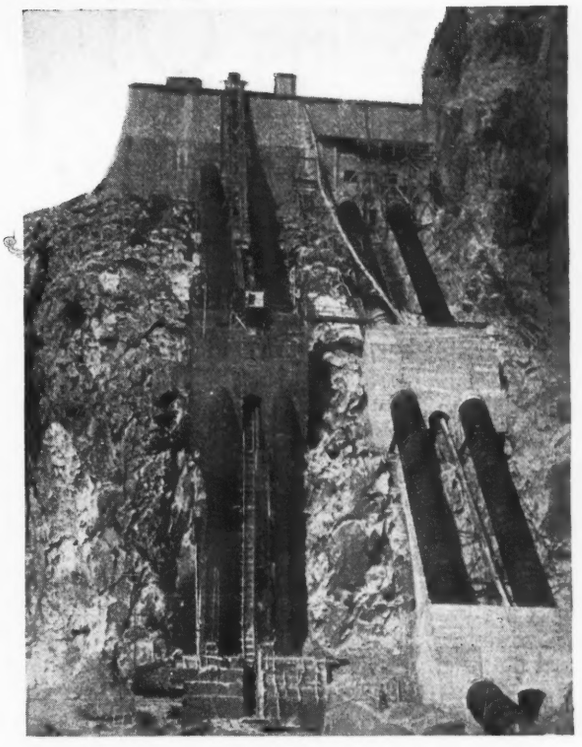
A 34-700-kva. water-power plant has been built by a Swiss company on the Drava River in the vicinity of Maribor, and the power is distributed through a fifty-



Kralyevac water-power plant in Dalmatia has 82,000 kva. capacity

mile over-head transmission line. This plant is connected to a steam station at Trbovlje. The capital of Croatia, Zagreb, has a large fuel-burning plant, which is connected to a small water-power station at Karlovac. The rating of the Zagreb power plant is 19,500 kw., the largest turbine-generator having 10,000 kw. capacity.

The most important fuel-power plant in Yugoslavia is the one supplying the capital. The power station of Belgrade is owned by a Swiss company and is being increased by installing three 6,000-kva. turbine-generator units. A Swedish company owns a number of power plants in the northeastern and southern part of the country. The output of these power plants is small, as units of only 200 to 300 kva. are used. A large power



Penstocks of the Kralyevac plant

plant to supply power to all the towns in this section is under construction.

An American firm recently acquired the concession for a 5,000-kva. power plant at Novi-Sad. It is possible that the company will extend its interest in the near future, as a larger power supply is needed in this part of Yugoslavia.

Water-power plants to the number of 57 have been installed in Yugoslavia. The number of steam plants, including engine-driven generators, supplying electrical current for electric light and power has reached 115.

▼

Calking Leaky Pipe Threads

A LEAK in a threaded pipe line can generally be stopped by calking, but it will usually be found more profitable to take down a leaky joint and remake it, cutting new threads if necessary. In case of an emergency, proceed as follows: Procure some pieces of lead, either sheet, wire, or bits of pipe, and cut them into small pieces of an ounce or two in weight.

Procure a small hammer and a calking tool made from at least $\frac{7}{8}$-in. hexagonal steel. Make the calking edge at least $\frac{1}{4}$ in. thick and as wide as the steel will work. Shape the sides of the tool with a bevel at least 2 in. long and make the end slightly bevelled, so that when the tool is laid flat against a pipe the end of the tool will be square with the side which rests against the pipe. Round off the lower corner of the tool enough to get rid of a sharp corner.

Place a piece of lead against the leak, or in the corner between the pipe and the fitting, and drive it in with the calking tool. As the lead is flattened by the tool, roll it into thickness again, and do not strike the tool unless there is a fair thickness of lead between the tool and the fitting.

Lubricating Oil Cleaned by Pressure Filtration

By WALLACE H. MARTIN
Professor Heat Engineering
Oregon State Agricultural College

RECENT RESEARCH has shown that oil does not wear out, but loses its value as a lubricant chiefly because of contamination. There are several sources of this contamination that need only to be mentioned to be recognized by the operating engineer.

All air contains some dust. In industrial districts the air may contain as much as 20 grains per thousand cubic feet. This dust enters the engine with the air, unless filtered out, and although the greater part of it is swept out again with the exhaust, some of it is caught by the oil film on the cylinder walls and gets into the circulation system.

All oils deposit carbon when subjected to heat; excess lubricating oil results in deposit of more than the normal amount of carbon in the cylinder. Carbon will also be formed as a result of oil being thrown up inside of the trunk piston of certain types of single-acting engine. When it comes in contact with the piston head, cracking occurs and carbon is produced. These particles of carbon gradually accumulate and add to the contamination of the oil.

The ash in the fuel, while only a small amount remains in the cylinder, is very objectionable. It is composed of gritty materials such as oxides of aluminum and iron, silicates, quartz, and other abrasives. Some of it contacts with the film on the cylinder wall and is eventually carried down into the crankcase.

The metal particles that collect due to wear of engine parts also add their bit to the total.

The air in the crankcase is hot and the oil being thrown from the crankshaft is in a finely divided state. These conditions both contribute to oxidation of the oil with resultant deposits.

Removal of objectionable accumulations can best be accomplished by a continuous process. The method sometimes resorted to, of changing the oil periodically, is not only expensive but does not give a continuous supply of clean oil. New oil is a mixture of hydrocarbons and when subjected to heat the less stable compounds break down. After a period of use the compounds that remain are the more stable ones and they break down much less easily than those in fresh oil. In other words oil which has been in use for some time is better than new oil provided the undesirable accumulations have been removed.

One way of removing most of the objectionable con-

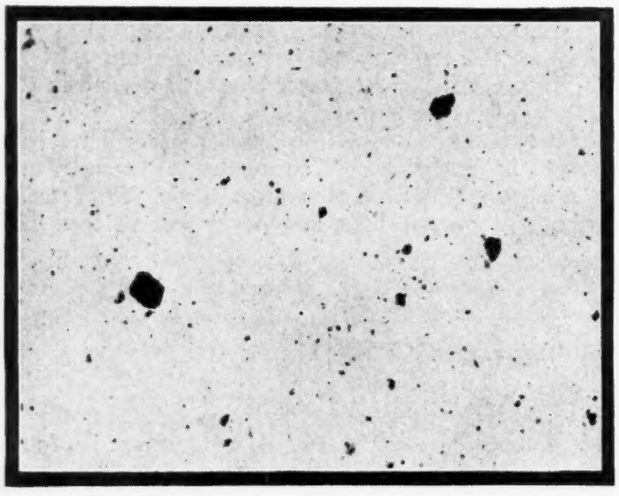


Fig. 1—Condition of lubricating oil prior to filtration

Cost of lubricating oil for Diesel engines varies between wide limits. A fair average is probably not far from one-eighth of the cost of the fuel oil. It is therefore pertinent that the factors that effect lubricating oil expense be given consideration. Once they are recognized, the necessary steps can be taken to reduce this item in the operating budget

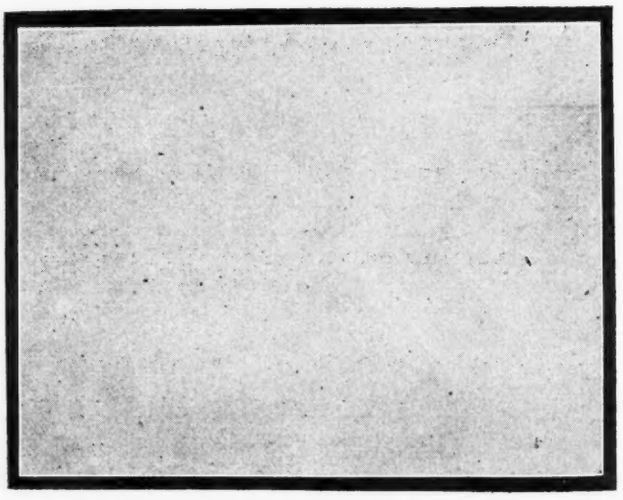


Fig. 2—Filtration efficiency is revealed by the oil's clearness

stituents is by filtering. The photomicrographs shown in Fig. 1 and Fig. 2 indicate what may be expected from an efficient filter. A 40-hp. four-stroke-cycle diesel engine was operated intermittently for about 50 hours before a filter was attached. A filter was then installed. Addition of more oil was necessary on account of the added volume of the filter body. The oil added was used oil. After the engine was operated for a short time to give opportunity for thorough mixing, samples

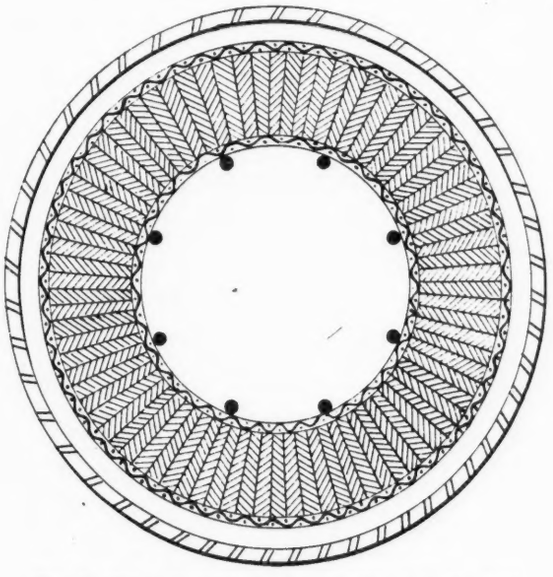


Fig. 3—Pressure type of filter employed in the test

were drawn for examination. The sample from which Fig. 1 was obtained was taken from the oil line just preceding the filter unit and the one from which Fig. 2 was secured was taken from the line immediately following the filter. The magnification was the same in each case, about 200 diameters by the microscope, and a special device was used to insure the same thickness of oil film in each case. The picture of the sample taken ahead of the filter shows very clearly that there is a considerable accumulation, while the second picture shows that the use of an efficient filter will effectually remove practically all the objectionable material.

The active element in the filter unit from which these results were obtained is shown in Fig. 3. It consists of two cylindrical wire baskets or cylinders about 12 inches high located concentrically. The annular space between these is filled with strips of felt about 1½ inches wide and 12 inches long placed in a radial position. Each felt strip when in place is of keystone cross-section compressed to give a unit pressure of about 95 pounds per square inch at the inner edge and about 17 pounds per square inch at the outer edge. Oil enters the filter core from the outside and the clean oil is removed from the center. The impurities in the oil enter the outer circumference fairly easily, but as they travel inward they become lodged in the felt owing to its increasing density.

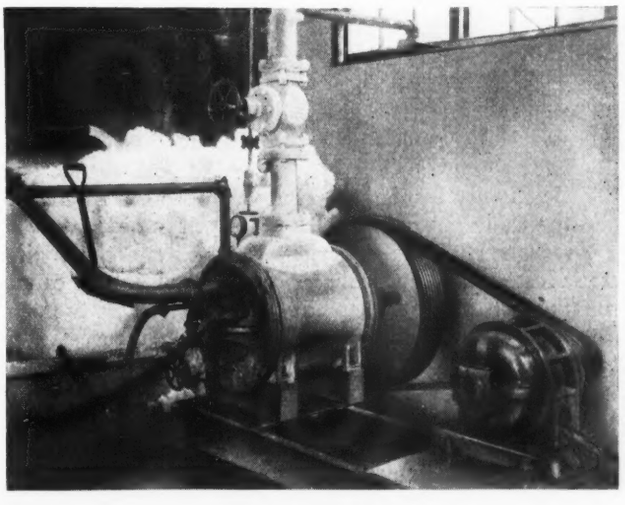
Cleaning of the unit is effected by by-passing the filter unit and letting compressed air into the center of the core. The air blowing through the felt in a direction opposite to that by which the dirt entered removes the collected material very quickly due to the radial arrangement of the felts. Tests have shown that two short blasts of air will quite thoroughly clean the solid particles from the felt core. Necessity for cleaning is indicated by the pressure drop through the core.

A New Ice-Making Machine

A DECIDEDLY NOVEL ice-making machine has been developed by the Vilter Manufacturing Company. This apparatus consists of a cylinder within which is located a set of paddles driven through the extended shaft. The cylinder is provided with a cored jacket in which ammonia is evaporated to freeze water passing through the cylinder bore; the frozen product, in the shape of snow, is deposited on the interior surface, from which it is removed by the internal machine.

The ice is washed out of the machine in a circulating stream of water and deposited in a pile as shown in the illustration. The water is constantly recirculated through the machine and make-up water is added continuously to take the place of the water which has been converted into ice. The ice made by this machine resembles wet snow and packs very readily and while it is not suitable for use in a household ice box, there are a number of other applications for which it is adaptable.

It might be thought that the power requirements to operate the interior mechanism of the machine would be excessive. Such is not the case, however, and upon analysis it is found that the power requirements of this machine compare very favorably with the power requirements of the conventional ice-making tank. In an ice tank, it is necessary to circulate the brine continuously, to harvest the ice by means of a motor-driven crane, and if cracked ice is wanted, the ice must be run through an ice crusher also operated by a motor. Of course, a certain amount of labor is required to perform these



Machine for snow melting

various operations, whereas with the machine illustrated, the ice can be gathered in any desired location.

An interesting development of the equipment is the manufacture of ice made of salt brine. It is quite easy to make ice which will have a melting point of —6 deg. F., using brine and, of course, this brine ice is a very desirable article for packing ice-cream cans in wooden shipping containers, or for placing in the tanks of refrigerator cars.

The equipment, no doubt, will prove to be of considerable value to the chemical industry as certain compounds can be readily precipitated out of solution at predetermined temperatures and with this equipment, the compound, when precipitated, can be removed from the solution the same as ice is removed from the circulating-water stream.

READERS' COMMENTS

Is Customer-Inspection of Plant Equipment Necessary?

WITH REFERENCE to the article by H. M. Friend in the Sept. 1 number, entitled "Is Customer-Inspection of Plant Equipment Necessary?" I should like to mention some observations I have made in the inspection field.

Materials that merely require surface inspection, checking of dimensions, quantities, etc., may be inspected at destination. The following paragraphs will give an idea of what the field offers in the way of inspection duds.

Navy Specification 44T7d for condenser tubes permits a tolerance of 0.005 in. over the outside diameter. One manufacturer offered tubes eccentric to the tune of 0.0085 in. and insisted that we accept material with a tolerance up to 0.010 in. outside diameter.

One order for corrugated tubes was beautifully "gummed up." The specifications called for a certain number of corrugations per foot. The outside diameter at the highest point of the arc was given. Contractor offered tubes with three different numbers of corrugations per foot, the greater the number of corrugations the higher the arc and vice versa. Contractor expected me to remain and segregate the acceptable from those unacceptable and took exception to my refusal to accede to his request.

At time of inspection of electric cable I was informed that the high potential test was given a few days prior to my visit and another was unnecessary. Upon my insisting that I witness another test one of the 1,000 ft. reels of No. 2 cable "blew" within the specified period of five minutes. This breakdown at the second test revealed faulty insulation. Had this not been discovered and the cable put into service the result is obvious.

Analagous to this experience let me cite the hydrostatic test on a venturi tube. A pressure of 150 lb. caused the huge casting to "weep" at every pore. This tube had also been given a prior test. The second test revealed the tube's defects.

Two compound generators to be "flat compounded at 120 volts" were ordered, but tests disclosed that they had been designed and built 5 per cent overcompounded because it "was the commercial thing to do." Resistance had to be shunted across the series coils to bring them back to required condition.

Specifications for a centrifugal pump with a gas engine on a common bedplate and shafts connected with a flexible coupling call for 62 per cent efficiency. Tests showed only 54 per cent efficiency. The gas engine furnished was rated at 125 hp. The b.hp. of the pump was 133. The engine manufacturer furnished a curve showing gas consumption for each of his engines. Upon checking the engine when running the pump mentioned it was found to be much higher than shown by the curve at various speeds. Also, the coupling was out of alignment. In spite of this the manufacturer took exception to my rejection. The reduced efficiency of the pump would have raised the cost of operation: the smallness of the gas engine would have resulted in overheating, scored cylinders and rods; and the misalignment of the coupling would have caused the overheating of bearings.

Copper bar, bronze rod, brass rod, etc., are given tensile strength tests as well as chemical analysis. Copper pipe is treated likewise. Brass pipe is given chemical analysis. All pipe is given hydrostatic tests.

All fittings and materials requiring galvanizing are given salt spray tests. If contractor has the materials on hand for tests they are conducted in his laboratory. If not, we send samples to our own laboratory for tests. The same holds good for all metals.

Wire rope is given over-all break tests and individual wire tensile strength tests, all at contractor's plant.

All paints, varnishes, soaps, inks, pastes, chemicals etc., are analyzed at our own laboratory after the inspector takes samples from the lot offered and lot is properly sealed.

Let me caution the purchaser regarding the 10 per cent "racket." Contractors often, after materials have been rejected, offer their product at a reduction of 10 per cent in price. What a chance for dishonesty if the contractor is permitted to practice this! He will bid or rather underbid without any attempt to furnish material according to specifications. If the material is rejected as he expects it will be, he offers it at a 10 per cent reduction in price and if this is accepted he has "beat" the legitimate purveyor. Should the inspector "slip up" on inspection and accept the material, what a grin the contractor will wear.

So, with the late Colonel Goethals, permit me to say, "inspect everything!"

S. ROSENBERG.

Panama Canal.

Effect of Damper Regulation On Boiler Efficiency

COMPLETE combustion and efficient operation depend both upon the amount of air admitted and the manner in which it is admitted. It would be hard to determine which causes the most waste: too much air admitted, causing heat loss in the dry stack gases; or too little air, causing unburned fuel to escape both in the form of CO and unburned carbon. Improper damper control can cause either or both of these losses.

Heat loss from excess air may be determined by computing the heat loss in the dry stack gases for different percentages of excess air. This may be done by multiplying the specific heat of flue gases, 0.24, by the difference in temperature between the flue gases and the atmosphere, and then multiplying this product by the weight of the flue gases in pounds.

Losses from insufficient air are serious, since every pound of carbon in the ash means a loss of approximately 14,000 B.t.u., the heat value of a pound of carbon burned completely to CO_2. If the carbon is burned to CO, the heat loss is about 70 per cent as much, or 9,800 B.t.u. per pound, because only 4,200 B.t.u. out of the 14,000 is released. It can then be seen that CO losses are likely to be as great as carbon losses, and much harder to detect and cure, for it will not be evident by a casual inspection, like the loss from carbon in the ash, but only by flue gas study and analysis.

Where several boilers operate on one stack, there should be a damper in the uptake of each boiler, with a main damper in the flue near the stack. The damper in each uptake makes it possible to regulate the draft in the individual furnace to suit that particular boiler.

Regulation of the rate of steaming of a battery may be accomplished by using the main damper. Where the load is steady, the main damper may be set to give the proper draft and will seldom have to be changed. No two boilers in a battery represent exactly the same requirements, for the reason that the location relative to the stack alone is sufficient to cause a difference in draft. The steam lines perhaps are not identical, causing steam to be drawn from one more freely than the other, or the setting of one may admit more air than another. These differences make it necessary to regulate the draft of each boiler independently of the others.

Bituminous coal contains a large percentage of hydrocarbons that are driven off quickly after the coal is thrown on the fire. To consume these gases properly a large amount of air should be admitted at this stage of firing. After the coal has become coked, less air is needed. The main damper in the stack controls the time and duration of increased or decreased draft according to the steam pressure, while the individual dampers are regulated to suit the general requirements of each boiler.

It can be seen that even where there is but one boiler the proper firing requires constant watching to get best results. For this reason automatic fuel, air and damper control are desirable. Where artificial draft is used it is best that the blower speed be changed with variation in steam pressure. Where the load varies widely the fuel feed also should be automatically controlled.

Mission, Texas. R. H. PARRISH.

Explosions From Flooded Oil Furnaces

WHILE READING an article in the Sept. 15 issue of *Power*, p. 399, stressing the importance of accident prevention equipment on oil lines, it occurred to me that a description of two accidents along the same line, that happened in a large industrial plant, may stress the need of such prevention and that something more than a spring-loaded diaphragm safety cut-off valve is needed on fuel oil supply systems to provide adequate protection against explosions, fires, line and fitting breaks and other such accidents.

The plant mentioned had a central, high-pressure oil-pumping station, that supplied oil to the burners of a number of forging, heat-treating and other shop furnaces, in addition to the burners of the power boilers. The main pipe line to each department was equipped with twin oil strainers. In addition small individual strainers were located close to the burners where necessary.

The first accident occurred in the boiler house at night when the main line strainer to the boiler house was changed over, by the boiler-house helper, preparatory to being cleaned. Being sleepy and unmindful of what he was doing, he turned one of the strainer cut-off slides the wrong way, thereby shutting off the supply of oil to the boilers. The fireman, noticing the decrease in flame, opened the boiler valve wider and went outside to see if anything was wrong at the oil pumping station. Noticing no signs of anything wrong, he returned, and still getting no oil he went to the forge shop door, some fifty feet away to see if they had oil. When he saw that they had it, he immediately came back to his boilers to shut off the burner valves, realizing that something local was preventing him from getting oil. As he bent down to shut off his first burner valve he also opened his peep-hole slide just as a terrific explosion occurred in the boiler, wrecking the baffles, cracking the side walls and badly burning the fireman. Investigation showed that the boiler-house helper, seeing the boilers were getting no oil, checked the strainer valve positions and found them wrong. Instead of informing the engineer or fireman, as to what he had done and perhaps being reprimanded, he opened the wrongly closed valve very slowly, allowing the oil to dribble into the firebox until such time as sufficient pressure had built up in the line to permit atomizing. When this occurred, the oil that dribbled into the firebox ignited at once with a violent explosion. It might be said that the fireman should have closed his burner valves as soon as his pressure dropped; but the practice of igniting the oil from the incandescent brick work is used frequently, even though known to be dangerous.

This plant ordered spring-loaded safety shut-off valves for all the distributing mains after this accident occurred, upon the advice of the Bureau of Combustibles. Despite the installation of these safety shut-off valves another explosion occurred.

The second explosion and fire occurred in the early morning in a forge-shop furnace. These furnaces were lighted about 5 o'clock each morning in order that the billets of steel in them be up to heat when the press operators came to work. This condition required the forcing of these furnace fires to the utmost. The morning of the explosion, the oil pump-station operator had trouble with the plant pressure-line safety valve remaining open. This dropped the line pressure to a few pounds. The forge-shop fireman did not close off the extra valves when the oil pressure dropped, as he had been told that the safety shut-off valve would work in an emergency and there was no danger. He left his fires as they were and went to the pumping station to find out the cause of the oil shortage. While he was there the troublesome safety valve closed and full pressure was again restored to the line. When he went back to his shop one of the furnaces and the adjacent floor was a mass of flames. An explosion evidently had occurred when the dribbled, low-pressure oil, seeping into the firebox, had ignited when the pressure was restored. The explosion split an elbow in the oil-burner line and the oil sprayed over the hot furnace in a burning mass. Investigation showed the diaphragm, spring-loaded, safety shut-off valve for this department to operate satisfactorily, but it was found that the self-contained by-pass in this valve was open, rendering the valve ineffective. The person who opened the valve could not be found and from the amount of dust on the hand-wheel, the opening was not recent.

The above is an example of a plant that was thought to be amply protected when in reality it was not. These spring-loaded diaphragm safety shut-off valves are excellent protection, but unless the by-pass valves can be sealed shut and the seals inspected at frequent intervals, an element of danger is introduced. When these by-pass valves can be opened and forgotten, the purpose of the valve is defeated.

As a suggestion, I think that a small $\frac{1}{2}$-in. spring-loaded automatic check valve, located close to the burners (that would require hand operation to open), would be a valuable supplement to the spring-loaded diaphragm valve. If for any reason the main safety shut-off became ineffective, these small checks would prevent oil passing through and prevent the furnace from flooding with oil. WILLIAM ANDERSON.

Brooklyn, N. Y.

FROM AMONG READERS' PROBLEMS

Conducted by

L. H. MORRISON

SETTING STEAM GAGES — *Our steam plant is equipped with water-tube boilers generating steam at a pressure of 375 lb., with the safety valves set to blow at 420 lb.*

There is a 37-ft. waterleg on the boiler pressure gage, that is, the boiler pressure gage connection is taken from the top steam drum and runs down the front of the boiler for a distance of 27 ft. This means that the pressure gage will indicate pressure in the steam drum plus that of the waterleg.

One engineer claims that the gage should read "deadweight" pressure, while a second says that the gage should read "deadweight" pressure minus the waterleg of 27 ft., which is equivalent to about 16 lb. per square inch more. A.C.B.

The purpose of the gage is to indicate the actual steam pressure in the boiler; consequently, the gage should be set deadweight minus the pressure due to the water head in the pipe. A better way to set the gage is to place a tee, valve and short nipples at the top of the gage line and attach a master gage at that point. The working gage is set to conform to the master gage.

PUMPING GRAVEL—*A dredge pump is to be chosen to deliver 15,000 gal. per minute of water containing 20 per cent solids, the solids consisting of sand and gravel having a specific gravity of 3.0.*

The pump is to be submerged and the distance from the water level to the highest point of discharge is 50 ft. The pump suction consists of 100 ft. of 22-in. pipe and one short radius elbow; the discharge consists of 200 ft. of 20-in. pipe and four long radius elbows.

What head must be obtained on testing the pump with fresh water to be certain of obtaining specified delivery when dredging? A.F.

The whole question in a problem of this kind is at what figure to place the friction losses through the pipe line. It has been found that when pumping from 10 to 25 per cent solids Williams & Hazen's hydraulic table with $C = 100$ gives just about what the friction losses would be. Therefore the friction losses in the suction line would be 7½ ft., and in the discharge line 19 ft., the equivalent length of pipe on the suction being approximately 200 ft., and in the discharge 360 ft. This would make the total head on the pump $50 + 7.5 + 19 = 76.5$ ft. This would be the same head the pump would have to develop regardless of whether it were handling clear water or a percentage of solids.

The specific gravity of the liquid does not enter into the figure of the total head the pump should develop, but will effect the pressure gage reading. The specific gravity does not enter into the calculations until the horsepower is to be figured. In this particular case the efficiency of the pump would be around 65 per cent, so that when handling clear water the pump would be drawing about 446 hp. at the shaft.

To get the actual power required by the pump when handling the 20 per cent solids, it is necessary to multiply the figure of 446 hp. by the specific gravity of the liquid. You give the specific gravity of the sand and gravel as 3.0. If this is correct, the specific gravity of the mixture would be about 1.4. Experience, however, has been that sand and gravel, instead of having a specific gravity of 3.0, has a specific gravity approximately 2.0, which would make the specific gravity of the mixture 1.2. If, as you state, the specific gravity of the sand and gravel is 3.0, then the pump when handling the 20 per cent solids would require approximately 446x1.4 = 624 b.hp. If, on the other hand, the specific gravity of the sand and gravel is 1.2, the pump would require 535 horsepower.

To sum up, the total head in feet of liquid on any pump whether handling clear water or liquids heavier than water, or liquids lighter than water, is the sum of the friction losses in the line plus the static head or lift.

The horsepower consumed by the pump is equal to the horsepower when pumping clear water multiplied by the specific gravity of the liquid.

LEAD WITH ECCENTRIC CHANGE—*Please explain why the lead of a slide valve is unchanged when the eccentric center is shifted perpendicular to the center line of the crank.* D.M.

The statement is not exactly correct, for the lead does change with a change in the eccentric center, although the change is slight. As shown in the illustration, the valve is at the point of admitting steam to the head end of the cylinder and the crank is at head dead center. The position of the eccentric is *OB*. If the eccentric center is shifted to *C*, along the line *CB* perpendicular to the crank line *AO*, the valve will be pulled slightly to the left; but, by reason of the large ratio of the eccentric rod *CD* to the eccentric arm *OB*, the movement of *D* is negligible. Practically the statement in the question is correct.

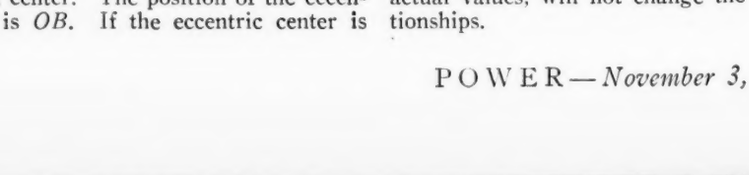


Diagram of eccentric action

COMPRESSOR HORSEPOWER—*We operate a system of low pressure air lines, 30 lb. gage, from compressors in our power plant, but to obtain air for one process we operate a motor-driven compressor which takes its air from the 30-lb. line and discharges at 132 lb. gage. It has been suggested that the power house compressors be speeded up so that the discharge will be raised from 30 lb. to 45 lb. gage, but the point has been made that the motor driving the compressor in the mill would be overloaded, as the work of compressing air increases with an increase in the suction pressure. Should we interpose a reducing valve in the suction of this compressor to hold the pressure to 30 pounds?* R.P.M.

If the suction pressure is increased, with a constant discharge pressure, the horsepower required by a single stage compressor will increase to a maximum at some critical suction pressure and will then fall off in the suction pressure is increased beyond this critical value.

The horsepower formula is:

$$\text{Hp.} = \frac{144}{33{,}000} \times \frac{N}{N\text{-}1} \times p_1 V_1 \left[\frac{P_2}{P_1}^{\frac{N-1}{N}} - 1\right]$$

Where

N = The adiabatic compression exponent, which for air is 1.41.

P_1 = Suction pressure, lb. per sq.in. abs.

P_2 = Discharge pressure, lb. per sq.in. abs.

V_1 = Cubic feet of suction air per minute.

To show how the horsepower varies, let it be assumed that the cubic feet of suction air handled by the motor-driven compressor is 1,000 cu.ft. per minute. The horsepower at various suction pressures, with the discharge pressure constant at 147 lb. abs., or 132.3 lb. gage, will be:

	Gage	Abs.
209	0	14.7
260	14.7	29.4
272	22	36.7
276	29.4	44.1
274	36.8	51.5
268	44.1	58.8
244	58.8	73.5

It is obvious that the increase of the suction pressure from 30 to 45 lb. will result in a slight decrease in motor output. In these calculations the compression is assumed to be adiabatic, that is, the compressor cylinder is not cooled; but jacket cooling, while altering the actual values, will not change the relationships.

Digest of Readers' Opinions On the Previous Question

GROUND CONNECTIONS are used for various purposes on power systems. Sometimes these are an important part of the protective equipment, and if not maintained in good condition serious damage may occur to circuits and equipment. I should like to hear from readers of Power *how they determine if ground connections are in good condition, how frequently they test them and what they do to maintain them at a low resistance.* E.E.C.

READERS who have answered this question are in general agreement as to the proper methods of determining if the ground resistance is low, but differ somewhat as to the frequency of testing and offer several different methods of grounding and of renewal of the ground.

The over-all resistance may be found by the use of a Wheatstone bridge or by the "fall of potential method," E. N. Anderson, Austin, Minn., points out, and remarks that the Wheatstone bridge is the most suitable and accurate, instructions for its use being found in any handbook on electrical engineering.

The fall of potential method, Mr. Anderson explains, is made with a voltmeter and ammeter, checking the voltage between the grounded point of the circuit, or lightning arrester and an auxiliary rod or pipe driven into the ground, or an independent piping system, while a definite current is flowing through the ground connection. The auxiliary rod or independent piping system should be at least 10 to 20 ft. from any other piping or ground system through which the test current is made to flow.

On the other hand, Gordon R. Hahn, Astoria, L. I., prefers to check the ground by determining the resistance between the ground at hand and a ground known to be in good condition, but some distance away; the resistance between two grounds should be practically zero. To determine the resistance, Mr. Hahn says, a current should be passed through a conductor and the two grounds in series. Knowing the supply voltage and resistance of the conductor, the resistance of the ground may easily be calculated. As previously mentioned, the resistance should be close to zero, a few ohms at the most.

A strong indorsement of the use of a ground ohmer is made by R. J. McCullough, Long Island Lighting Company, Bay Shore, L. I. He states it is self contained, direct reading and simple enough to be handled by substation operators, in which view he is seconded by R. H. Parrish, Mission, Tex. In disagreement with this view, E. A. Roberts, Southwestern Public Service Company, Carlsbad, N. M., thinks that while various methods have been worked out making use of ohmmeters, good results are possible by testing with light fuses. If a 10-amp. fuse will blow on a ground at 110-volts the ground resistance is low enough in most instances. If it will not blow, the resistance is too high, and if a 5-amp. fuse will not blow it is certainly time to reduce the resistance. But Mr. Parrish observes in his letter that experiment has shown that the resistance will vary inversely with the precipitation throughout the year. The amount of the variation with precipitation will often be as much as 400 to 600 per cent. For example, a ground having a resistance of 20 ohms during the extreme rainy months may have as much as 120 ohms during the dry fall months.

Somewhat surprisingly, readers differ widely as to the frequency of testing. One treatment is sufficient, according to the experience of Mr. McCullough, who adds that some grounds on the system with which he is connected are four years old. E. H. Anderson takes the stand that the frequency of testing will vary according to local conditions. If clean, dry, non-corrosive conditions exist, inspection at intervals of six months should be ample, while if installed subject to moisture and corrosive elements, inspection at periods of 30 days would be proper. In this he has the support of Mr. Roberts. G. R. Hahn suggests that if a ground connection is once in service and is known to be of low resistance, it is unnecessary to make tests as long as all connections are well soldered and soil conditions remain the same.

The same engineer remarks that a good ground connection may be made by attaching the neutral of the electrical system to the steel framework of the building. If such a method is not possible a copper plate may be buried several feet in the earth, or iron pipes 1 to 2 in. in diameter and 4 to 6 ft. in length may be driven into the soil. If the earth is very dry the efficiency of the ground may be increased by pouring salt water over the area near the copper plate or iron pipes. In certain localities where rock strata and a dry soil prohibit a good ground the only solution is to attach the system neutral to the water piping.

Treating with salt is also advocated by Mr. McCullough, who believes that the best method is to set a 6-in. earth tile adjacent to or around each ground rod, filling the tile with salt and water. But E. N. Anderson objects that the addition of salt or brine around the ground pipe has not proved to be of much value. It is corroded or loose connections which cause the increase in resistance, and these should be kept clean. Mr. Roberts, located where there is considerable cooperation between electric and water companies, expresses the opinion that probably no better ground can be secured than to large water pipes, and water companies generally allow this, as no harm can result from alternating current systems.

However, pipes are not always available, he adds, and the use of copper-weld ground rods is probably the most satisfactory method of grounding. Several copper-weld rods in parallel are better than one large rod, and the rods should be separated from 4 to 6 ft. and must be long enough—never less than 8 ft.—to reach permanently damp earth. Many soils do not make good grounds and the use of salt around the rods is necessary. The salt collects and holds moisture and lowers the soil resistance. Copper-weld rods resist the corrosive action of the salt; but iron rods or pipes, often used for grounds, will be quickly destroyed by its action.

Again quoting Mr. Parrish, in the event a ground is discovered to have a resistance above a set amount for the particular location, the electrician is supposed to remedy it if it can be done without interrupting service or schedule, and in any event report the condition to the proper superior. Certainly where there is reason to doubt that a ground has lost its effectiveness, and the means are not at hand to test it, the safe thing is to break all the old connections and remake them, substitute new grounding wire for the old, and, in the case of a ground made with salt, dissolve all the old salt with water, put in new charge of salt and recover as when building it new.

A Question for Our Readers

TWO BANKS of three 150-kva. transformers are connected delta-delta and in parallel on the primary and the secondary sides. If one transformer was to burn out would it be possible to connect the two remaining transformers open-delta and operate them in parallel with the delta-delta connected bank? If this can be done will the open-delta connected bank have any effect on the capacity of the delta-delta connected transformers? All these transformers are alike, having been supplied by one manufacturer. M.A.B.

Suitable answers, if received promptly, will be paid for when published

THE ENGINEER'S BO

Heat Engine Textbook

HEAT ENGINES. *Fourth Edition. By John R. Allen, late professor of mechanical engineering, and J. A. Bursley, professor of mechanical engineering at the University of Michigan. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1931. Cloth 6x9 in.; 526 pages, numerous illustrations. Price, $4.*

USUALLY a fourth edition of an engineering textbook calls for but little review comment but the sale of 43,750 copies of the last editions leads one to examine the book with a view of ascertaining the reason for its popularity. As the authors point out, this is intended as an elementary text book on heat engines, and it must be conceded that as such the volume is excellent.

The new edition includes advances in heat engines that have occurred since the third edition was published. In spite, however, of the experience and reactions obtained from former editions, the authors have included a few statements open to question unless elaborated upon by the lecturer or instructor. For example, the authors stated that it follows from the second law of thermodynamics that no engine can convert more than a small fraction of the heat given it into work. Engines, both steam and oil, are able to show 30 per cent efficiency, which is by no means small. Then too, the second law merely postulates that heat will not flow from a cold to a hot body without outside assistance, and does not cover probable engine efficiency.

Likewise, such statements as "overloading a boiler does not injure it, since as long as it is transmitting heat to the water, no harm is done," will call for some exposition by the lecturer, for boiler tubes have bent, blistered and burned due to forcing and poor circulation. But after all these criticisms are of minor importance when the quality of the book as a whole is considered.

Scientific Dam Design

THE DESIGN OF DAMS. *By Frank W. Hanna, chief engineer, and Robert C. Kennedy, chief designing engineer, East Bay Municipal Utility District, Oakland, Calif. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1931. Cloth, 6x9 in.; 456 pages, 87 illustrations, 40 tables. Price, $5.*

SOME of the disastrous dam failures during the last decade have given added significance to the absolute necessity for the safe design of dams. The increasing use of these structures and their increased size has intensified the need for complete and scientific methods of design. In this book the authors have endeavored to supply this need.

In the 23 chapters all the different designs of dams have been treated. These include various types of gravity dams, deck dams, different types of single- and multiple-arch dams, rock-filled dams and earth dams. All the fundamental equations have been developed so that the engineer or student who desires to follow through their derivation may do so. The important equations have been plainly identified so that they may be readily used.

A chapter on the accessories for dams, deals with spillways, gates, valves, flashboards, logways and fish ladders. Dam failures have been treated and a list of failures of various types of dams is given and the causes of their failure.

Chapter II, which comprises 72 pages, is devoted to rainfall and stream flow. The maximum observed flood discharge rates and expected runoff are given for nearly 1,000 drainage areas in the United States. Rainfall characteristics for over 800 localities in various parts of the world are also included.

This book is highly technical and is intended for engineering students and practicing engineers. To these classes of readers the work merits careful consideration.

Testing Lubricants

PETROLEUM PRODUCTS AND LUBRICANTS, METHODS OF TEST. *Compiled and published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa.; 1931. Paper, 6x9 in.; 267 pages, illustrated. Price $1.25.*

THE ANNUAL REPORT of Committee D-2 of the A.S.T.M., this book contains 33 standard methods of test and 14 tentative test methods for petroleum products and lubricants. Tests are given for the determination of bitumen; burning quality of kerosene oils and of mineral seal oils; carbon residue of petroleum products; cloud and pour points; color of lubricating oils, of petrolatum and of refined petroleum oil. Tests for the dilution of crankcase oils, distillation of crude petroleum, gasoline, naphtha, etc., flash points, gravity by means of the hydrometer, and the analysis of grease are also given.

Included are standards for testing electrical insulating oils; melting point of paraffine wax and of petrolatum; penetration of bituminous materials and of greases and petrolatum; precipitation number of lubricating oils; sampling; saponification number; softening point of bituminous materials; sulphur in gasoline and in motor fuels, etc.; also tests for thermal value of fuel oil; vapor pressure of gasoline; viscosity of petroleum products; water and sediment in petroleum products, and several other standard methods of test.

A.C. Commutator Motors

THE COMMUTATOR MOTOR. *By F. J. Teago, professor of electrical machinery at the University of Liverpool, England. Published by E. P. Dutton & Company, 300 Fourth Ave., New York City; 1931. Cloth, 4x6½ in., 80 pages, 31 diagrams. Price, $1.10.*

THIS LITTLE BOOK deals with commutator-type alternating-current motors. These include variable-speed types, power-factor correction types, combined speed and power-factor control types and commutator-type motors connected in cascade with induction motors. Particular attention is given to the mechanism of energy transference as a means of speed and power-factor control. The book is one of a series on physical subjects intended to supply readers of the average scientific attainment with a compact statement on modern developments.

Electrical Engineering

ELECTRICAL ENGINEERING. *Fourth Edition. By Clarence V. Christie, consulting engineer and head of the department of electrical engineering at McGill University. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1931. Cloth, 6x9 in.; 662 pages, 570 illustrations. Price, $5.*

ALTERNATING CURRENTS. *Fourth Edition. By Carl E. Magnusson, professor of electrical engineering and director of the Engineering Experiment Station, University of Washington. Published by McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1931. Cloth, 6x9 in.; 685 pages, illustrated. Price $5.*

A STANDARD TEXT for electrical engineering students, the first book discusses the theory and characteristics of electrical circuits and machinery from the standpoint of their application to the problems of the practicing engineer. Among the additions in this new edition

'S BOOKSHELF

are a short outline of the mathematical relations required for the solution of problems in alternating-current theory, the design of a commutating-pole direct-current generator, a discussion of the problem of system stability and a set of typical problems dealing with some of the more important questions to be answered by the electrical engineer.

The second book presents a discussion of the fundamental principles of alternating currents, with illustrations of their application to industrial problems. The book aims to give a clear concept of what actually takes place in alternating-current machinery, to explain the relation between the factors involved and to express physical facts in mathematical forms so that the student can use equations rationally in the solution of everyday industrial problems. In the fourth edition much new material has been added, including new chapters on "Systems of Units and Symbols, "Mercury-Arc Rectifiers," and "Hot-Cathode Rectifiers and Oscillators."

Compressor Heat Transfer

DER WÄRMEÜBERGANG IM LUFTKOMPRESSOR (Heat Transfer in Air Compressors). *By Dr.-Ing. Karl Kollmann. Forschungsheft 348 published by the VDI-Verlag, Dorotheenstr. 40, Berlin N.W.7, Germany; 1931. Cloth, 8x12 in.; 22 pages, charts and tables. Price, 5 marks.*

BY PAINSTAKING RESEARCH, the conditions under which heat transfer takes place in internal-combustion engines have been accurately ascertained. Also for reciprocating steam engines valuable data on heat transmission between the steam and the cylinder walls are today available. But there is a conspicuous lack of information about machines with lower working temperatures, such as air compressors.

This book fills in the gap by presenting the results of detailed calorimetric research on a two-stage air compressor. By this investigation, the influence of engine speed, back pressure and mean cooling-water temperature upon the heat transfer between the air and the cylinder wall is elucidated. The inquiry embraced a speed range of between 60 and 160 r.p.m., a back pressure range between 14 and 250 lb. per sq.in. above atmospheric pressure, and mean cooling water temperatures of from 90 to 120 deg. F.

The coefficients of heat transfer obtained under various operating conditions in part widely differ from each other, but are mainly dependent upon the air flow in the interior of the cylinder. In all cases, the influence of the compressed air is notably low. High moisture content in the air favors rapid heat exchange.

In the course of a working cycle, it always happens that water is precipitated in drops on the cylinder walls. For this reason, any increase in the cooling-water temperature generally leads to unfavorable heat transfer. With increasing working pressure, the coefficient of heat transfer, after exceeding a maximum, approaches a low limit value. This fact would seem to indicate that at high pressures and temperatures, heat-transfer conditions in a compressor approach those in an internal-combustion engine.

A comparison of the heat-load values with those for steam engines and internal-combustion engines shows that the quantity of transferred heat per square unit and per hour rises very markedly with the increasing operating temperature. This proves that data on heat transfer referring to internal-combustion engines cannot be directly applied to engines of other types.

BRIEF REVIEWS

PRACTICAL MATHEMATICS FOR HOME STUDY. By Claude E. Palmer. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City; cloth, 606 pages, diagrams and tables; price $4.—This helpful book contains the essentials of arithmetic, geometry, algebra and trigonometry with their applications, conveniently arranged for home study.

INHALTS-VERZEICHNIS DER ZEITSCHRIFT DES VEREINES DEUTSCHER INGENIEURE, 1926-1930. Compiled and published by the VDI-Verlag, Dorotheenster. 40, Berlin NW 7, Germany; 138 pages; price 8 marks.—A complete bibliography of German technical papers on engineering subjects.

LIFE CHARACTERISTICS OF PHYSICAL PROPERTY. By Robert Winfrey and Edwin B. Kurtz. Published as Bulletin 103 by the Engineering Experiment Station, Iowa State College, Ames, Ia.; 144 pages, charts and tables.—Describes a method of calculating the mortality, probable life and rate of renewal of physical equipment, together with applications to 65 sets of life data for property found in various utilities and industries.

TABLES OF ELASTIC PROPERTIES OF ALLOYS. Compiled by C. H. Kent. Published as Bulletin No. 2 by the Engineering Experiment Station, University of Nevada, Reno, Nev.; 52 pages, 35 tables; price 20c.—A compilation showing the composition and elastic properties of the principal steels and non-ferrous alloys, with endurance properties and variations under high temperatures.

COMPARATIVE PROPERTIES OF LUBRICATING OIL MADE FROM ELKO, NEVADA, SHALE OIL. Edited by F. H. Sibley. Published as Bullein No. 1 of the Engineering Experiment Station, University of Nevada, Reno, Nev.; 31 pages illustrated.—An investigation of the possibilities as a lubricant of shale oil.

TRANSACTIONS OF THE NEWCOMEN SOCIETY, VOL. IX. Compiled and published by the Newcomen Society, The Science Museum, South Kensington, London S. W. 7, England; cloth, 170 pages, illustrated.—Contains interesting historical material on pumping stations railroads, iron and steel mills, agricultural machinery, etc.

A BIBLIOGRAPHY OF BIBLIOGRAPHIES IN ELECTRICAL ENGINEERING, 1918-1929. Compiled and published by The Special Libraries Association, 345 Hudson St., New York City; price $1.50.—Contains approximately 25,000 references under nearly 2,500 different subject entries, one-third of which are in French or German.

TRANSACTIONS OF THE SECOND WORLD POWER CONFERENCE; VOLUME XX INDEX. Compiled and published by the VDI-Verlag, Dorotheenstr. 40, Berlin NW 7, Germany; cloth, 316 pages; price 30 marks.—The publication of this index volume completes the "Transactions of the Second World Power Conference," which was held in Berlin in June, 1931. The Transactions are a complete record of the work of the Conference, and this index lists over 350 technical papers and reports. The titles are given in the three official languages: English, French and German.

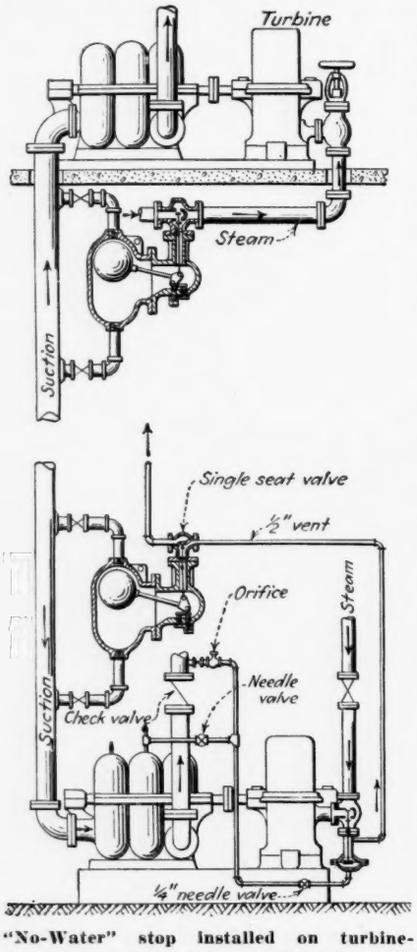
LAST MONTH the first issue of *The Steam Engineer* appeared. Edited and published monthly by John D. Troup, 34-35 High Holborn, London, W.C.1, England, this new technical journal is "devoted primarily to the economic generation and application of steam." *Power* welcomes its new contemporary and wishes it every success.

WHAT'S NEW IN PLANT EQUIPMENT

"No-Water" Stop for Centrifugal Pump

To OBVIATE the possibility of a centrifugal pump being operated with the suction valve closed or after the suction has failed, the Mercon Regulator Company, 53 W. Jackson Blvd., Chicago, Ill., has developed a new application of the liquid level controller known as a float-operated "No-Water" stop. In the case of a motor-driven pump, the "stop" operates a small switch in the control circuit of the motor starter. The device can be applied readily to existing, as well as new, installations.

The top view shows the stop applied to a turbine-driven pump. Depending upon the direction taken by the suction line, the float may be placed above or below the floor level. It will be seen that a float-operated valve controls the flow of steam to the turbine. When the suction line is full of water, the float chamber also is full of water, and the float holds the steam valve wide open. Should the water recede in the suction, it will also pass out of the float chamber, causing the float to drop and, in so doing, close the steam valve and stop the turbine. For this service the float is 8 in. in diameter and is made of KA2 stainless steel.



"No-Water" stop installed on turbine-driven pump and used in combination with excess-pressure regulator

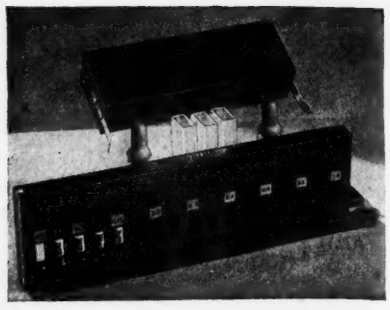
Designs also have been made to use the float-operated "No-Water" stop in combination with the standard Mercon excess-pressure pump regulator. From the description of the regulator, appearing in *Power* of Nov. 11, 1930, it will be recalled that steam pressure on one side of a diaphragm and the pump discharge pressure on the other side control the admission of steam to the driving turbine, and therefore the speed and capacity of the pump. Instead of being located directly in the steam line to the turbine, the float-operated valve of the stop is placed in a ½-in. vent line from the steam side of the diaphragm. Owing to the small size of the line and the valve, the float can be made relatively small, and depending upon the direction taken by the suction line, it can be placed above or below the floor.

As in the previous case, the float drops when the suction line empties, opening the ½-in. vent valve, which in turn relieves the pressure above the diaphragm of the excess-pressure regulator. The feed header pressure under the diaphragm then closes the valve in the steam line to the turbine. It will be noticed that contrary to usual practice, the regulator piping containing the orifice is connected above the check valve in the discharge line of the pump, to insure pressure being available to close the regulator.

New Chlorine Comparator

FOR THE CONTROL of chlorine in water, sewage, industrial wastes, etc., W. A. Taylor & Company, Inc., 872 Linden Ave., Baltimore, Md., have brought out the Enslow slide chlorimeter illustrated. The outfit is also suitable for use in power plants where chlorine treatment is used to stop the growth of the algae, etc., in condensers.

The instrument is molded from bakelite and works on the slide principle. It consists of two principal parts —the slide and the base, and contains 9 color standards, ranging from 0.0 to 1.0 p.p.m. of chlorine and 8 ampoules of distilled water, the latter alternating with the color standards. The lower part of the base contains a slot in which the slide may be moved back and forth, two holes containing vials of ortho tolidine and three holes containing molded Pyrex glass cells 89x25x11 mm. The upper half of the base serves as a cover for the vials and cells when the set is not in use and is fastened to the lower part by means of spring catches.

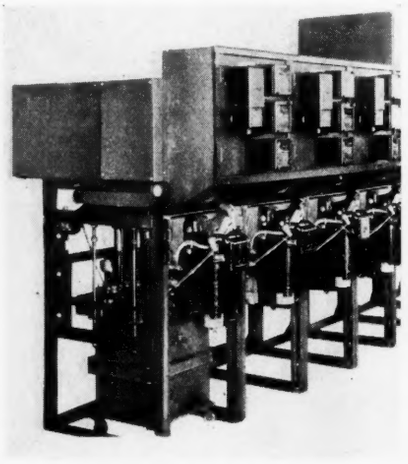


Enslow slide chlorimeter

A determination of chlorine with this outfit consists of only three simple operations: (1) The three cells are filled to the mark (11.5cc) with the sample to be tested and placed in the three holes in the base. (2) To the central cell 0.5 cc of ortho tolidine solution is added and the contents thoroughly mixed. (3) The slide containing the chlorine standards is placed in position on the base and is moved back and forth in front of the test sample until a color match is obtained. The chlorine content is then read directly from the values on the front of the slide. Each set is supplied in a wooden case 11x3.75x4.75 in. with a handle for carrying.

Metal-Clad Switchgear

AN ADDITION to its line of metal-clad switchgear, designated Type MI-3, has been made by the General Electric Company, Schenectady, N. Y. This type accommodates oil circuit breakers having an interrupting capacity of 65,000-kva. at 7,500 volts, and is available in normal ratings up to 1,200 amp. The



Type MI-3 metal-clad switchgear

units can be furnished with manual, solenoid or motor-operating mechanisms.

The new switchgear is designed to meet a definite need in both industrial and public utility fields. It is smaller, and yet it embodies the important features of other G.E. metal-clad equipment, such as small over-all dimensions, inclosure of live parts, easy installation and quick withdrawal and replacement of breaker units.

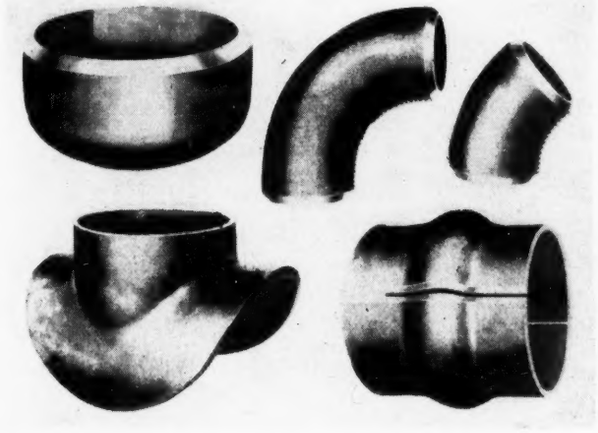
Welding Fittings

WELDING FITTINGS in a variety of shapes and sizes are now being put out by the Midwest Piping & Supply Company, Inc., 1450 South Second St., St. Louis, Mo.

The welding ells are made from one piece of plate with one welded longitudinal seam along the inner circumference. The ells are made from the same material as mild steel pipe and so have the same coefficient of expansion and the same welding characteristic. One-quarter inch of tangent is provided for each inch of pipe diameter.

Made with a comparatively long tangent so that the circumferential weld to the pipe is entirely in tension and not subjected to shear and bending, the sleeve is used to reinforce a butt line weld between two lengths of pipe. It relieves the butt weld of bending stress and much of the tensile stress.

The saddle is designed for reinforcing the junction of the neck and body of a welded header. The neck is welded to the body in the usual manner then the saddle is slipped down and welded into place with a heavy bead.



Welding fittings include head, 45 and 90 deg. ells, saddle and sleeve

Totally Inclosed Fan-Cooled Motor

THE TOTALLY INCLOSED fan-cooled squirrel-cage motor for use in explosive atmospheres developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., meets the latest specifications for use in Class I. Group D hazardous locations.

Motor for use in explosive atmospheres

Free passage of cooling air is provided by large air passages and large spaces between the guard and the nonsparking aluminum alloy fan. Air inside the motor is kept in constant circulation by fan blades on each end of the rotor. The pre-wound primary core is interchangeable and renewable.

Metal for Industrial Castings

PROMAL, a metal originated by the Link-Belt Company, 910 South Michigan Ave., Chicago, Ill., for its own chain products, is now available for use in other fields. Characteristics of the new metal are great strength and resistance to wear.

Of a specially processed malleable iron, it can be heated repeatedly to a maximum of 1,000 deg. F. and cooled without affecting its physical properties, thus making it a desirable material for use on low-temperature heat-treating equipment, or for parts which are to be hot-dip galvanized. It is said to have a uniform structure throughout its cross-section, and unusually high yield point and high fatigue strength and elongation indicates its ability to withstand heavy loads repeatedly without permanent distortion or failure.

Copper-bearing Promal can be supplied where exceptional resistance to corrosion is desired. By the addition of suitable alloying elements in the making of the metal, ultimate strengths up to 100,000 lb. per square inch, with a yield point of 75,000 lb. per square inch and 10 per cent elongation in 2 in. are possible.

All-Steel Gage for Severe Service

THE HEAVY-DUTY all-steel gage, Style AIH, brought out by the Crosby Steam Gage & Valve Company, Boston, Mass., is designed especially for service where rapidly pulsating pressures and vibrations are encountered, as on high-pressure, high-temperature oil cracking, modern high-pressure steam station and synthetic chemical plants. It is said to be unaffected by many chemicals and fumes which ordinarily attack bronze, such as sulphur and ammonia.

The pressure tube is machined from a solid bar of special alloy steel. The tube is rolled to shape and radius, heat-treated and tempered. It is attached to the socket and tip by threads, giving a mechanical joint suitable for the highest temperatures. The movement is entirely of steel and the bearings are of stainless steel hardened and polished. Sector and pinion are wide-faced and forged and the teeth are machined, then hardened and chromium-plated to resist wear.

A socket of forged steel supports the complete operating mechanism of the gage, and it extends well below the case and is milled to provide a wrench-fit. The case is dust- and moisture-proof.

Crosby gage with alloy-steel pressure tube

New Self-Leveling Burette

AN IMPROVED self-leveling burette brought out by the National Aluminate Corporation, 6222 West 66th Place, Chicago, Ill., is shown in the illustration. The advantage of this burette over the former model is its compactness and simplicity.

It is 16½ in. high and the reservoir will hold 500 c.c. The reservoirs are marked for soap, acid and silver nitrate, the latter being a brown bottle to keep out light. The burette itself hold 10 c.c. and is standard equipment in all the water-testing kits distributed by the company, excepting the traveling kit.

NEWS of the FIELD

Coal Utilization and Economics Chief Topics Of Third International Bituminous Conference

ALMOST every phase of coal utilization will be discussed at the Third International Conference on Bituminous Coal in Pittsburgh, Pa., on Nov. 16 to 21. As announced by Dr. Thomas S. Baker, organizer of the conference and president of Carnegie Institute of Technology under whose auspices the world gathering is being held, the program lists nearly 100 papers by scientists of fifteen nations, including many who are recognized as authorities in the several fields of coal research.

For the first time a section on the economics of the coal industry will be included in the conference. Because of the desperate condition of the industry throughout the world, the organizers felt it would be impossible to hold any major discussion on coal without considering this side of the industry. Speakers in this section include Governor Albert C. Ritchie of Maryland; Myron C. Taylor, chairman of the finance committee of the United States Steel Corporation; Dr. W. T. Thom, Jr., of Princeton University; C. E. Bockus, president of the National Coal Association; and Alfred C. White, of the National Industrial Conference Board.

Pulverized coal will also come in for major discussion. Three sectional meetings will be held, at which eleven papers will be presented. Other sections of the conference will be concerned with smoke and dust; gasification, hydrogenation and liquefaction; low- and high-temperature distillation; coal cleaning and preparation; by-products; origin and classification; domestic heating; metallurgy; and competition of coal with other fuels.

Among the distinguished foreign scientists who will be present are Dr. Franz Fischer, director of the Kaiser Wilhelm Institute for Coal Research; Professors R. V. Wheeler and Cecil H. Desch, University of Sheffield, England; Dr. Friedrich Bergius, of Heidelberg; Richard Roosen, Friedrich Schulte and Rudolf Pawlikowski, of Germany; Dr. Ernst Berl, of Darmstadt; C. M. Stein, industrialist of Paris; and André Kling, director of the Municipal Laboratory of Chemistry, Paris.

Papers of particular interest to power engineers include: "Slag-Tap Furnace and Its Effect Upon the Selection of Coal for Pulverized-Coal Firing," E. G. Bailey; "Progress of the New Coal-Dust Motor," Rudolf Pawlikowski; "Theoretical and Practical Aspects of Pulverized-Coal Firing," E. H. Tenney; "Transportation of Pulverized Coal," Friedrich Schulte; "Mechanism of Combustion of Coal," S. P. Burke; "Study of the Mechanism of the Combustion of Pulverized Coal," André Grebel; "Experimental Study of the Process of Combustion of Pulverized Coal," R. A. Sherman.

"Interrelationships of Coal, Petroleum and Natural Gas," W. T. Thom, Jr.; "Rationalizing Smoke Elimination Methods," V. J. Azbe; "Prevention of Smoke in Metallurgical Operations," C. H. Desch; "Elimination of Sulphur Compounds From Boiler Furnace Gases," H. F. Johnstone; "Competition Between Natural Gas and Coal," R. B. Harper; "Natural Gas and Bituminous Coal," G. I. Rhodes; "Economics of Water Power Versus Steam Power," G. A. Orrok.

"Value of Clean Coal for Steam Production," E. B. Ricketts; "Burning of Bituminous Coal on Large Underfeed Stokers," Bert Houghton; "High Combustion Densities in Restricted Furnace Space," Harald Nielsen; "Development of Grate Firing in Germany," Friedrich Schulte; "Brown and Bituminous Coal in German Power Plants," Friedrich Münzinger; "Combustibility of Pulverized Fuel in the Coal-Dust Engine," T. Suwa; "Pulverized Fuel for Steamships," R. J. McKechnie; "Use of Coal on Shipboard," C. J. Jefferson; "European Progress in Use of Pulverized Coal in Steamships," C. M. Stein; "Some Aspects of Fuel Research," F. S. Sinnatt.

Stoker Manufacturers Hold Annual Meeting

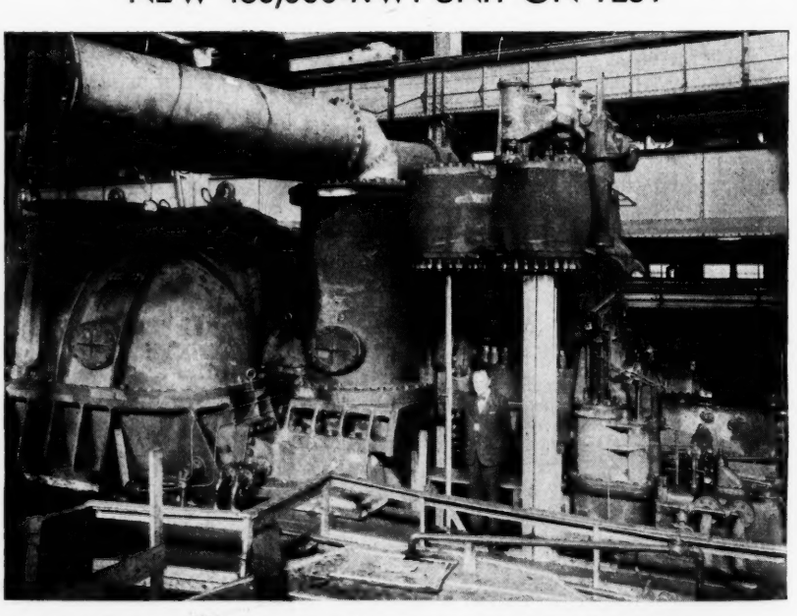
THE STOKER MANUFACTURERS' ASSOCIATION held its annual meeting on Oct. 26 to 28 at Seaview Golf Club, Absecon, N. J.

J. G. Worker, president, called attention to the reduction of smoke and sulphur dioxide discharged into the atmosphere, improvement in boiler-room working conditions and personnel, and changes in the coal-mining industry as the result of the creation of new markets for the sizes of coal fired by the smaller stokers.

T. A. Marsh, forecast the develop-

▼ ▼ ▼

NEW 160,000-KW. UNIT ON TEST



When Floyd L. Carlisle, chairman of the board of the Niagara Hudson Power Corporation, recently paid a visit to the Schenectady plant of the General Electric Company, he inspected the second 160,000-kw. steam turbine-generator being assembled for test before shipment to the Hudson Avenue Station of the Brooklyn Edison Company

ment of a "Heat Service" in metropolitan areas by companies that would install small stokers and supply complete service to operate them. It will be as easy, he said, to keep the stoker hoppers filled and remove the ashes as it is to ice a refrigerator in the home.

John Lovett, general manager of the Michigan Manufacturers' Association, was guest speaker.

Plant Atkinson Goes in Service at Full Capacity

AFTER A YEAR of idleness except for a brief period of operation at the time of its dedication, in Oct. 1930, during which it has been available as a stand-by, or reserve source of power, Plant Atkinson, the Georgia Power Company's 75,000-kw. steam-electric generating station on the Chattahoochee River near Atlanta, began operating recently at full capacity to relieve the situation caused by water shortage in the reservoirs of Northeast Georgia hydro plants and in the Chattahoochee River.

At present, the hydro plants are being operated only during hours of heaviest load.

Although the deficiency in rainfall is greater than at any previous time, the company states that all danger of "power famine" has been eliminated by preparations for such emergencies, through construction of Plant Atkinson and interconnection of lines with those of other states.

Political Academy to Discuss Power This Week

A CONFERENCE on the general topic "Power and the Public" will be held by the American Academy of Political and Social Science at Witherspoon Hall, Philadelphia, Pa., on Nov. 6 and 7. Six sessions will be held, at which important phases of the general topic will be discussed by men prominent in academic, business and public life.

At the first session James C. Bonbright, Columbia University, and John T. Flynn, New York, will speak on the "Field and Function of the Holding Company." Edwin Gruhl, The North American Company; Harold Evans, former member, Pennsylvania Public Service Commission; W. S. Lee, W. S. Lee Engineering Corporation; and Leland Olds, The Power Authority of the State of New York, will discuss "Rates —Domestic, Commercial and Power" at the second session, while "Regulation: Federal and State" will be the topic of the third session with Governor Gifford Pinchot, of Pennsylvania, and Col. William J. Donovan, former Assistant Attorney-General of the United States, the principal speakers.

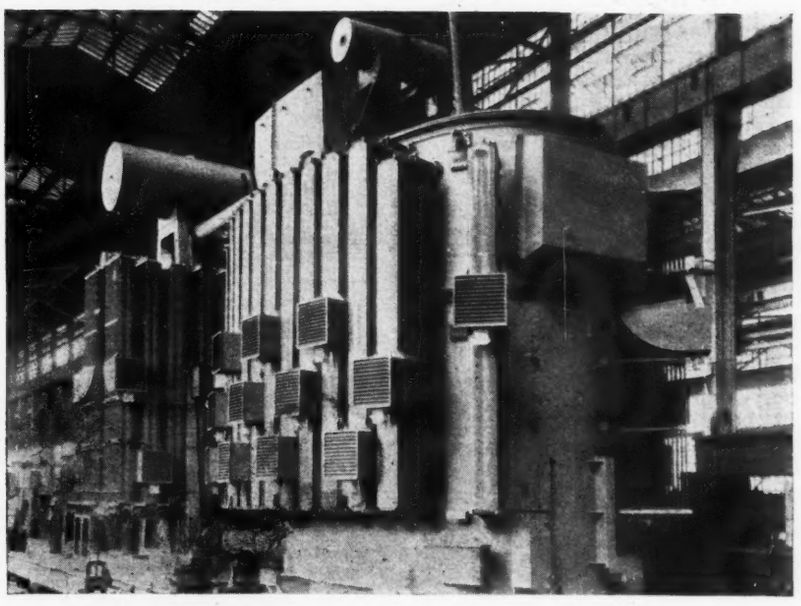
The fourth session will be devoted to a discussion of "Valuation," by William L. Ransom, American Bar Association; Henry C. Atwell, Massachusetts Department of Public Utilities; Richard J. Smith, Yale University; and Chester I. Hall, Hall Electric Heating Company. "Public and Private Ownership" will be discussed by Joseph B. Eastman, Interstate Commerce Commission; S. Ferguson, Hartford Electric Light Company; and Orren C. Hormell, Bowdoin College, at the fifth session, while the sixth and last session will be given over to a discussion of "Our Electrical Future," by Matthew S. Sloan, New York Edison Company, and Donald R. Richberg, National Conference on Valuation of Railroads.

Bagnell Hydro Plant Placed in Operation

OPERATION of the $30,000,000 hydro-electric plant of the Union Electric Light Company of St. Louis, on the Osage River near Bagnell, Mo., began on Oct. 19, Louis H. Egan, president of the company, has just announced. The plant will develop 268,000 hp., and energy is transmitted to St. Louis and to St. Francois County to serve the mines and smelters of the St. Joseph Lead Company. The Bagnell Dam and power plant were constructed by the Stone & Webster Engineering Corporation.

Three small steam plants belonging to the St. Louis Company—in Venice and Alton Ill., and River Mines, Mo.—are to be closed temporarily, but will be held in readiness for emergency use. The closing of the three plants will save 100,000 tons of coal a year.

LARGEST TRANSFORMER FOR HELL GATE



Transformer capacity for a single unit reached a new maximum when the Westinghouse Electric & Manufacturing Company recently shipped from its Sharon Works a 70,000-kva. unit to the Hell Gate Station of the United Electric Light & Power Company in New York. Weighing 220 tons, the unit is 28 ft. high and requires 750 sq.ft. of floor space. It is the world's largest self-cooled two-winding rating ever built

▼ ▼ ▼

N.E.L.A. Hydro Committee Discusses Plant Economy

FURTHER STUDY of hydro plant simplification and operating economy was recommended at the recent meeting of the Hydraulic Power Committee of the National Electric Light Association. In addition to the present subcommittee on operating problems, it was suggested that a separate subcommittee on efficient operation be appointed to stimulate interest in the unsolved problems of economic operation and promote a closer understanding between design and operating engineers.

Another interesting topic suggested for consideration concerns the obsolesence of earlier power plants that have been operating long enough to indicate the probable life and service of hydraulic equipment, especially where it is a question of continuing operation or not due to advances in the art, increased maintenance and other factors that might make it desirable to replace the older machinery with new.

While there is comparatively little building in the hydro-electric field at present, except on projects started before the depression, it was the opinion of the committee that with the passing of the economic crisis water power and steam would prove more than ever complementary sources of power through the development of interconnections and a fuller appreciation of the economic relation between the two. The progress of railroad electrification, it was felt, would tend to create a demand for future hydro developments

At the meeting a report of the Operating Problems Subcommittee on

"Spare Parts and Life of Runners" together with a progress report on "Vacuum Breakers" were passed upon and recommended for publication. The committee now has ready for publication a report of particular interest on "Economics of Hydro-Electric Plants" and will shortly submit for approval the report on "Penstocks."

Work to Start Soon on Herndon Steam Station

FINAL APPROVAL of the plans and specifications for the 50,000-kw. steam plant to be built by the San Joaquin Light & Power Corporation at Herndon, Calif., about 11 miles north of Fresno, has been given and construction will be started in the next two or three months. The project comprises a power plant, a substation, and a pipe line for the transmission of natural gas from Kettleman Hills at a total cost of $6,210,000. The substation is practically completed and has been in operation since July of this year. Harold K. Fox, chief construction engineer for the San Joaquin Company, will supervise the erection of the steam plant, which is expected to be ready for operation by the summer of 1933. Its cost is estimated at $4,610,000, that of the pipe line at $1,000,000, and the substation, adjacent to the power plant, was built at a cost of $600,000, making the total of $6,210,000.

Manufacturers Association Discusses Relief Plans

A CROSS-SECTION of what industries and municipalities are doing to combat unemployment and stabilize business was presented at the 36th annual meeting of the National Association of Manufacturers, which was held in the Waldorf-Astoria Hotel, New York City, on Oct. 29 and 30. The general consensus of opinion at the meeting was that industry must take the initiative in stabilization and work out sound programs for the relief of unemployment, or face the possibility of government doles and political interference.

William G. Rose described the Cleveland balanced labor program, which proposes the equalization of hours of labor to give maximum employment; M. B. Folsom analyzed the Rochester unemployment benefit fund, that provides for the creation of reserves by each company; General Electric unemployment relief activities were discussed by W. W. Trench; and the remarkably effective program of the New England Council was described by J. W. Hook.

The work of municipalities was outlined by George M. Welsh, city manager of Grand Rapids, Mich., who told about the already famous "scrip jobs" given to the unemployed of that city; by Mayor Francis T. Maloney, of Meriden; and by Francis E. B. McCann, of Delaware.

COMING CONVENTIONS

American Society of Mechanical Engineers. Annual meeting in New York City, Nov. 30-Dec. 4. Secretary, Calvin W. Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. Annual winter convention in New York City, Jan. 25-29, 1932. Secretary, F. L. Hutchinson, 33 West 39th St., New York.

American Society of Refrigerating Engineers. Joint meeting with the A.S.H.V.E. and annual convention at the Hotel Cleveland, Cleveland, Ohio, Jan. 26-29, 1932. Secretary, David L. Fiske, 37 West 39th St., New York City.

American Water Works Association. Annual convention at the Hotel Peabody, Memphis, Tenn., May 2-6, 1932. Secretary, Beekman C. Little, 29 West 39th St., New York City.

International Acetylene Association. Annual convention at the Congress Hotel, Chicago, Ill., Nov. 11-13. Secretary, A. C. Morrison, 30 East 42d St., New York City.

National Association Practical Refrigerating Engineers. Annual convention and exhibition at the Municipal Auditorium, Houston, Tex., Nov. 10-13. Secretary, Edward H. Fox, 435 North Waller Ave., Chicago, Ill.

Seventh Annual Conference on Welding, to be held by the Engineering Extension Department of Purdue University at Lafayette, Ind., Dec. 10-11. Professor in charge, W. A. Knapp, Engineering Extension Department, Purdue University, Lafayette, Ind.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

L. P. Alford Receives Gantt Medal Oct. 29

THE HENRY LAURENCE GANTT MEMORIAL MEDAL was presented to Leon Pratt Alford of New York City at a special dinner held in his honor at the Hotel Pennsylvania, New York City, on Oct. 29. The presentation was made by E. O. Griffenhagen, president of the Institute of Management of the American Management Association.

Roy V. Wright, president of the American Society of Mechanical Engineers, spoke on the subject, "Research in Engineering Economics."

The Gantt Medal is given annually in recognition of outstanding accomplishment in management engineering in memory of Henry Laurence Gantt, who was one of the leading contributors to the development of the science and art of management.

Mr. Alford has devoted his life to the advancement of the art and science of management, as editor of technical periodicals, publisher of technical and business books, contributor of numerous papers before engineering societies.

Personals

F. B. STEELE, formerly first vice-president and general manager of the Utica Gas & Electric Company, has become associated with Orrok, Myers & Shoudy, engineers of New York City. Mr. Steele plans to make his headquarters in Utica. He and his associates will carry on a general consulting engineering business, specializing in power plant and mechanical undertakings. During his connection with the Utica utility, Mr. Steele superintended many important improvements to the steam and hydro stations.

COL. MARCEL GARSAUD, of the Federal Power Commission, has returned to Washington, D. C., after visiting 30 water-power projects in the West to acquaint himself first hand with some of the principal licensees under the water power act in that section of the country. He was particularly impressed, he stated, with the need of careful study to determine in certain instances whether reclamation or power constituted the more beneficial use of water to the public.

DR. H. FOSTER BAIN has resigned as secretary of the American Institute of Mining and Metallurgical Engineers, effective Nov. 1, to become affiliated with the Copper and Brass Research Association, of New York City. A. B. PARSONS, assistant secretary of the Institute, will succeed Dr. Bain for the duration of the latter's term, which expires Feb. 15, 1932.

R. J. GAUDY, formerly executive engineer of the Sessions Engineering Company, has dissolved all previous connections and under the firm name, R. J. Gaudy Engineering Services, 228 North La Salle St., Chicago, announces engineering services in the following activities: engineering, designing, economics; industrial processes, fuel and basic material conversion, manufacturing cost correction; power, fuel and energy economies; operating and project technical counsel.

ADMIRAL S. M. ROBINSON, who last spring succeeded Rear Admiral H. E. YARNELL as chief of the Bureau of Engineering of the United States Navy, has been appointed the representative of the Navy Department on the Standards Council of the American Standards Association.

D. W. PEABODY, for the past 25 years connected with the southeastern office of the General Electric Company in various engineering, sales and executive capacities, has opened consulting engineering offices at 588 Linwood Ave., Atlanta, Ga. Mr. Peabody will specialize in mechanical and electrical engineering —making surveys, developing designs and layouts, supervising construction, process and operation, and serving in a general consulting capacity.

Business Notes

GEORGE W. MOORE COMPANY, Chicago, Ill., has merged with the H. W. Caldwell & Son Company, a subsidiary of the Link-Belt Company, Chicago. The combined companies will be known as the Caldwell-Moore Division of the Link-Belt Company. Max H. Hurd, formerly president of the Moore company, becomes vice-president of Link-Belt, in charge of the Caldwell-Moore operations, with headquarters at 2410 West Eighteenth St., Chicago. It is announced that there will be no modification in the policies of the two companies and no change in the diversity and character of their products.

GENERAL ELECTRIC COMPANY, Schenectady, N. Y., announces that L. U. Murray, district manager of the industrial department, east central district, has been appointed manager of the Graybar-Western Electric department with headquarters in Schenectady, to succeed R. S. Johnstone, deceased. J. P. Jones, manager of the machinery manufacturers section of the industrial department, has been appointed to succeed Mr. Murray as manager of the industrial department, east central district, and J. J. Huether has been named to succeed Mr. Jones as manager of the machinery manufacturers' section.

THE PERMUTIT COMPANY, New York City, announces that Francis D. West, after nearly two years as sales manager of the Paradon Company, has returned to the Permutit Company as district sales manager with headquarters at 712 Brisbane Building, Buffalo, N. Y. Mr. West was formerly associated with the Permutit Company from 1918 until the first part of 1930.

FOOTE BROS. GEAR & MACHINE COMPANY, Chicago, Ill., announces the appointment of L. W. Erickson, a mechanical engineer of wide experience in power transmission problems, to succeed E. L. Parsons as district representative for the Milwaukee and Wisconsin territory, effective Nov. 1.

BINGHAM PUMP COMPANY, Portland, Ore., announces that due to the increase in its business a third shift will be added at once and for the balance of the year operations will be on a 24-hr. daily basis.

ASSOCIATED ENGINEERS COMPANY, Chicago, Ill., announces the appointment of Dana Harland as manager of sales. For the past fourteen years Mr. Harland has been connected with one of the largest fuse manufacturers in the country.

REPUBLIC STEEL CORPORATION, Youngstown, Ohio, announces that George E. Totten has been appointed manager of sales of the tin plate division, with headquarters in the general offices of the company.

How's Business?

BROAD MEASURES of general business volume are being distorted by abnormal banking conditions and by the steady narrowing down of trade to local activity which is not included in the national indicators, according to *The Business Week*, Nov. 4. The decline in check payments, which brings our index to a new low level this week, reflects in large part the return of business to a cash currency basis in many localities. The consumer necessity industries, catering to immediate short-range requirements, continue encouragingly active, but the big basic construction and equipment industries still show no sign of stimulation by obsolescence or investment expansion, and probably none is to be expected in the next two months.

Power production by public utilities for the week ended Oct. 24 was 1,646,531,000 kw.-hr., or 5.8 per cent below the corresponding period last year, according to N.E.L.A. figures.

Trade Catalogs

SWITCHGEAR, MOTORS, CABLE—General Electric Company, Schenectady, N. Y., has recently issued two bulletins on "Automatic Switchgear and Associated Supervisory Systems for Industrial Service" and "Automatic Switchgear and Associated Supervisory Systems for Railway Service." Other new publications of the company include: GEA-1309A on switchgear for merchant ships; GEA-246C on general purpose synchronous motors; GEA-1475 on single-phase vertical motors; GEA-560B on constant-speed, single-phase motors; GEA-1483 on medium-speed a.c. generators; GEA-1312 on rubber and miscellaneous cable; GEA-940B on switchboard devices, panel and benchboard fittings; and GEA-1146A on electric furnaces.

GEARS—A technical description of the production of welded steel gears from blanks of Lukenweld construction, written by Everett Chapman, has just been published in an illustrated bulletin by Lukenweld, Inc., division of Lukens Steel Company, Coatesville, Pa.

PIPE TOOLS—The Borden Company, Warren, Ohio, has just issued a new condensed catalog (No. 32), which describes and illustrates a full line of pipe tools and machines.

FLEXIBLE COUPLINGS—The construction features and applications of Morse flexible couplings are well described and illustrated in Bulletin No. 47 just issued by the Morse Chain Company, Ithaca, N. Y. Besides full engineering data, the bulletin contains a useful table for selecting the proper coupling without calculation.

REFRACTORIES — McLeod & Henry Company, Troy, N. Y., announces that its new 1932 catalog on "Steel Mixture" boiler-setting arches and blocks, air-cooled furnace walls and "Carbex" silicon-carbide refractories is now ready for distribution.

▼

Fuel Prices

FUEL OIL

(Barrel = 42 U. S. gallons.)

Boston—(Oct. 28) Industrial use, f.o.b., per bbl: Bunker C, 70c.; Diesel, $1.40.

New York—(Oct. 29) Industrial use, f.o.b., per bbl.: Bunker C, 60c., terminal; Diesel, $1.30, refinery.

Tank-wagon delivery, per gal.: No. 1 (36@40 deg.), 8c.; No. 2 (32@36 deg.), 6.5c.

Philadelphia—(Oct. 20) Industrial use, f.o.b., per bbl.: Bunker C, 70c.; Diesel, $1.40.

Tank-wagon delivery, per gal.: No. 1, 7.5c.; No. 2, 6c.

Pittsburgh—(Oct. 20) Industrial use, f.o.b. local refinery, 36@40 deg., 2.5c.@ 2.75c. per gal.

Cincinnati—(Oct. 20) Industrial use, f.o.b., tank cars, per bbl., $1.25.

Tank-wagon delivery, per gal: No. 2, 6.5c.

Chicago—(Oct. 20) Tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.: 18@22 deg., 22.5c. per bbl.; 22@24 deg., 25c. per bbl.; 24@26 deg., 27.5c. per bbl.; 26@28 deg., 32.5c. per bbl.; 28@30 deg., 37.5c. per bbl.

St. Louis — (Oct. 20) Tank-car lots, f.o.b. St. Louis: 24@26 deg., $1.02 per bbl.; 26@28 deg., $1.095 per bbl.; 28@30 deg., $1.195 per bbl.; 30@32 deg., $1.245 per bbl.; 32@36 deg., gas oil, 2.776c. per gal.; 36@38 deg., distillate, 3.151c. per gal.

Dallas—(Oct. 20) Industrial use, f.o.b., tank cars, 22@26 deg., per bbl., 60c.

Gas oil, 34@36 deg., f.o.b., per bbl., 84c.

COAL

Bituminous	At Mine, for Shipment to	Price per Net Ton
Clearfield, mine-run....	New York.	$1.50@$1.75
Pittsburgh, mine-run...	Pittsburgh.	1.20@ 1.50
Pittsburgh, st. slack...	Pittsburgh.	.60@ .70
W. Ky., mine-run.....	Louisville..	.85@ 1.30
W. Ky., slack.....	Louisville..	.35
Fairmont, mine run....	Fairmont..	.90@ 1.10
Fairmont, slack.....	Fairmont..	.50@ .85
Smokeless, mine-run...	Cincinnati.	1.75@ 2.00
Smokeless, slack.....	Cincinnati.	.35@ .75
Kanawha, mine-run....	Cincinnati.	1.00@ 1.25
Kanawha, nut-slack...	Cincinnati.	.35@ .50
Smokeless, mine-run....	Chicago...	1.75@ 2.00
Smokeless, slack.....	Chicago...	.40@ 1.00
Harlan, Ky., slack.....	Chicago...	.60@ .90
Franklin, Ill., mine-run	Chicago...	2.15
Franklin, Ill., screen....	Chicago...	1.10@ 1.60
Ind. 5th Vein, m.-r....	Chicago...	1.20@ 1.75
Standard Ill., mine-run	St. Louis...	1.30@ 1.50

Anthracite	At Mine, for Shipment to	Price per Net Ton
Buckwheat.....	New York.	$3.25
Rice.....	New York.	1.75@ 1.85
Barley.....	New York.	.90@ 1.40

NEW PLANT CONSTRUCTION

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., San Diego—Charles Gabriel, San Bernardino, has been granted permit by City Planning Commission, of San Diego to construct a 50 ton ice manufacturing plant at 38th St. and El Cajon Ave. here. Estimated cost $40,000.

Conn., Holyoke—Holyoke Water Power Co., R. E. Barrett, Pres., 1 Canal St., awarded contract for power unit No. 8; 2 story, 35 x 50 ft. to LaFrance Construction Co., 292 Maple St. Estimated cost $40,000.

Ga., Augusta—City is revising estimates for the construction of a power plant. Cost $1,000,000. Burns & McDonnell Engineering Co., 400 Interstate Bldg., Kansas City, Mo., are engineers.

Ill., La Salle—City is having sketches made for the construction of a municipal electric light plant. Estimated cost $150,000. Burns & McDonnell Engineering Co., 400 Interstate Bldg., Kansas City, is engineer.

Ill., Rock Island—U. S. Engineers Office, will receive bids until Dec. 18 for a roller-gate dam, power house, intercepter sewer and seawall at Lock and Dam No. 15 on Mississippi River.

Ind., Fort Wayne—City awarded contract for two water tube steam boilers with superheaters, air heaters, etc., and two multiple retort underfeed mechanical stokers in connection with light and power plant, to Babcock & Wilcox Co., 85 Liberty St., New York. $127,700.

Ia., Fairfield—City, F. W. Goodman, Clk., defeated $40,000 bond election of Oct. 13 for construction of municipal light and power plant.

Ia., Lenox—City awarded contract for a 38 x 52 ft. light and power plant including two Diesel engines, total 500 hp., switchboard and all accessories, also complete distribution system to Fairbanks Morse & Co., 9th and Harney Sts., Omaha, Neb., $71,000.

Ia., Remsen—City, J. Gamerdinger, clk., is having plans prepared for the construction of a municipal light plant. Estimated cost $75,000. Charles A. Trimmer, Madison, S. D., is engineer.

Mass., Norfolk—Commonwealth of Massachusetts, Dept. of Public Works, Boston, awarded contract for the construction of underground steam mains, also conduit changes to R. H. Baker Co., 145 Broadway, Cambridge.

Mass., Watertown—U. S. Engineer, Watertown Massachusetts Arsenal, will soon award contract for thirteen gasoline electric power plants. Private plans.

Mich., Detroit—Detroit Zoological Commission, Nine Mile Road and Woodward Ave., is having plans prepared for a 1 story, 50 x 50 ft. boiler house with 60 ft. stack. Estimated cost $50,000. Donaldson & Meier, 1601 Washington Blvd. Bldg., are architects.

Mich., Wyandotte—City awarded contract for the construction of a 70 x 100 ft. boiler plant at Bishop Park to A. G. Christman Burke Co., Fisher Bldg., Detroit, $149,975.

Mo., Kansas City—City is having estimates made for industrial gas system. Estimated cost $3,000,000. Burns & McDonnell Engineering Co., 400 Interstate Bldg., Kansas City, is engineer.

Mo., Lees Summit—City plans an election Nov. 10 to vote $50,000 bonds for municipal electric light and power plant and distribution system, also water main extensions. W. B. Rollins & Co., 339 Railway Exchange Bldg., Kansas City, are engineers.

N. Y., Attica—Dept. of Mental Hygiene, State Office Bldg., Albany, awarded contract for refrigeration work for storage building at Attica Prison here to Carbondale Machinery Co., 642 Ellcott St., Buffalo. $43,936.

N. Y., Bedford Hills—Dept. of Correction, State Capitol, Albany, received low bids for a group of buildings including power plant equipment and service connections (tunnels) at New York State Reformatory for Women here.

N. Y., New York—Consolidated Gas Co., 4 Irving Pl., awarded contract for the construction of a pump house at Hunts Point Ave. and Bronx River to Bartlett-Haywood Co., 200 Scott St., Baltimore, Md. Estimated cost $50,000.

N. Y., Oswego—Oswego Independent Ice Corp., plans the construction of an 80 x 100 ft. cold storage plant. Equipment will be installed.

O., Cleveland—City plans construction of a pumping station and adminstration building for Parma Reservoir. Estimated cost $300,000. Herman Kregelius, City Hall, is engineer.

O., Piqua—City plans an election Nov. 3 to vote $810,000 bonds for the construction of electric light and power plant. Burns & McDonnell Engineering Co., 406 Interstate Bldg., Kansas City, Mo., is engineer.

Ore., Portland—City will soon receive bids for a 1, 2 and 3 story, 133 x 616 ft. public market including railroad connections, track sheds, refrigeration and cold storage room, etc. at ft. of Yawhill St. and River Front. Estimated cost $1,250,000.

Pa., Meadville—City, G. S. Maxwell, Clk., will receive bids until Nov. 10 for the construction of a sewage treatment plant including pumping station. Roy L. Phillips, is city engineer.

Pa., Pittsburgh—University of Pittsburgh, J. C. Bowman, Chn., plans the construction of a psychiatric hospital at Chara and DeSota Sts. Estimated cost $2,000,000. Louis Stevens, Century Bldg., is architect.

R. I., Bristol—City will receive bids during winter or early spring for construction of sewage treatment plant, and pumping stations in connection with intercepting sewer and cast iron mains. H. K. Barrows, 6 Beacon St., Boston, Consulting Engineer, in charge.

Tex., Amarillo — H. C. Badger and A. Davison, c/o Herring Hotel, awarded contract for a 70 x 145 ft. ice plant at 100 Garfield St. to Albert Randall, Amarillo. Estimated cost $50,000.

Tex., Harlingen—Frozen Juice Corp., c/o B. F. Pitman, plans the construction of a quick freezing plant, 3,000 gal. daily capacity. Private plans. Interested in quotations on equipment.

Vt., Newport—Newport Electric Light Co., awarded contract for the construction of a penstock to J. M. Swan Co., St. Johnsbury.

Wash., Okanogan—Okanogan Valley Power & Light Co., recently incorporated by R. P. Hodykn & Associates, plans the construction of a 6,500 hp. power plant on the Similkameen River in the near future.

Wis., Grafton—City is receiving bids for the construction of a sewage disposal plant and sewage re-lift station, including pump house, etc. Estimated cost $25,000. Paul S. Clark, Appleton, is engineer.

Ont., Hamilton—Mountain General Hospital, Mountain Park Ave., completed plans and will soon receive bids for addition to hospital building, including hot water heating and ventilation systems at Mountain Park Ave. Estimated cost $610,000. W. P. Witton, 7 Hughson St. S., is architect.

Ont., Port Arthur—Port Arthur Arena Co. Ltd., 176 Court St., awarded contract for a 142 x 264 ft. ice arena to J. Tocheri, 1010 Donald St., Fort William. Estimated cost $65,000.

Equipment Wanted

Boiler—Huntington, Ind.—City, will receive bids until Nov. 9 for furnishing and installing a 361 hp. water tube boiler, and complete boiler setting for municipal electric light plant. Estimated cost $25,000.

Engine—Bellevue, Ia.—City, L. J. Gaylor, Clk., will receive bids until Nov. 17 for two 300 hp. Diesel engines direct connected to 200 kva. generators for proposed extensions to light plant.

Engines, Generators, etc.—Sullivan, Mo.—City will receive bids until Nov. 12 for two Diesel engines, generators, exciters and auxiliaries, 500 hp. total capacity, also water cooling tower and 8 panel switchboard, 600 kw. ultimate capacity in connection with light and power plant.

Pumping Units — Marquette, Mich. — City plans installation of three electric pumping units, 13,500,000 gal. capacity, two of these units to be dual drive type with gasoline stand-by motors in connection waterworks improvements. Estimated cost $40,000.

Pump and Motor—Coalinga, Calif.—City rejected bids received Oct. 19 for a 1,000 g.p.m. deep well turbine pump and motor. Project in abeyance until spring.

Pumps, etc.—Caledonia, Ont.—Town will receive bids until Nov. 6 for pumps, etc. for proposed waterworks system. $25,000.

Regulators—Modesto, Calif.—Modesto Irrigation District, C. S. Abbott, Secy., will receive bids until Nov. 9 for furnishing and delivering three out-door type induction regulators.

Switchgear—Wellington, N. Z.—Dept. of Public Works, will receive bids until Feb. 2 for supply of additional 11,000 v. switchgear including 2 in. on load bus selector incoming transformer panels; one reactor panel, one bus car potential transformer panel, two bus sectionalizing panels, one reactor panel 2 in. on load bus selector incoming transformer panels, one synchronous condenser panel, one summation metering panel and six feeder panels, also for spares and loose parts for Lake Colridge Power Scheme.

Industrial Projects

Calif., Los Angeles—Los Angeles Soap Co., 617 East First St., will receive bids about Nov. 1 for first unit of soap and tallow factory, 1 story, 140 x 268 ft. Estimated cost $200,000. Morgan, Wells & Clements, 1135 Van Nuys Bldg., are architects.

Ind., Indianapolis—Beach & Arthur Inc., 221 West South St., manufacturers of paper, will build a 1 story, 40 x 104 ft. addition to factory at 2900 Columbia Ave. Estimated cost $40,000. Work will be done by owner's forces.

Kan., Neodesha—Standard Oil Co. of Kansas, will build addition to oil refinery. Estimated cost $250,000. Work will be done by day labor and separate contracts.

Mass., Everett (Br. Boston)—Merrimac Chemical Co., Chemical Lane, awarded contract for a 1 story, 60 x 100 ft. bottling plant to A. C. Peters, 46 Cornhill, Boston. Estimated cost $40,000.

O., Sandusky—Universal Pipe Co., plans the construction of a 1 story factory for the manufacture of metal piping. Estimated cost $40,000. Private plans.

Wis., Sheboygan—W. C. Weiks, 720 Ontario Ave., Archt., is receiving bids for a 2 story, 60 x 84 ft. factory on St. Clair St. for Hayssen Mfg. Co., 131 St. Clair St., manufacturers of bakers' machinery. Estimated cost $40,000.

Wyo., Casper—Standard Oil Co. of Indiana, 137 West 11th St., Indianapolis, Ind., awarded contract for the construction of a refinery (cracking unit) 6,500 bbl. daily capacity here, to M. W. Kellogg Co., 225 Broadway, New York, N. Y.

N. S., Baddeck—North American Gypsum Co., plans the construction of a gypsum plant. Estimated cost $150,000.

Ont., Guelph—Canada Gypsum Co., Hagersville, awarded contract for a 1 story gypsum factory, also four new kilns to C. Crenna, 204 Elizabeth St. New machinery and equipment will be required.